HP 3PAR S-Class/T-Class Storage System Physical Planning Manual

Abstract

This manual provides information that is useful for planning and preparing for the installation of HP 3PAR S-Class and T-Class Storage systems. Use this document in conjunction with the*HP 3PAR Systems Assurance and Pre-Installation Site Planning Guide* that details specific system configuration and installation information for your storage system and operating site. The information in this manual is intended for use by HP customers, in conjunction with the advice and assistance of an HP Sales Representative or Systems Engineer, for the purpose of planning an HP 3PAR Storage system installation. The installation of HP 3PAR Storage systems and hardware components is to be completed by qualified technicians who are authorized by HP. Authorized technicians include HP Field Engineers, Value Added Resellers (VARs), and authorized third-party field technicians.

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1 System Components and Specifications

This chapter provides detailed system specifications for the HP 3PAR S-Class and T-Class Storage systems and serves as a quick reference for other relevant specifications that are described in more detail in other chapters of this manual.

HP 3PAR Storage System Components

HP 3PAR Storage systems are based on the HP 3PAR architecture, a cluster-based approach that incorporates sophisticated data management and fault tolerance technologies that can meet the storage needs of smaller sites and can easily be scaled for global organizations.

The HP 3PAR S-Class and T-Class Storage systems are housed in a 2 meter cabinet and are comprised of the following components:

- **Controller Nodes** are high-performance, data movement engines that provide the caching capabilities and manage the flow of data in a storage system. HP 3PAR Storage systems contain two, four, six, or eight controller nodes depending on the backplane model and current system configuration.
- **HP 3PAR Storage System Backplane** works in conjunction with the controller nodes to route data. This passive, full-mesh backplane enables high-bandwidth and low-latency internal pathing that supersedes bus-, switch-, and even InfiniBand-based architectures.
- **Drive Chassis** houses the drive cages that, in turn, contain the drive bays. Each drive bay can accommodate a single drive magazine that holds an array of four hard disk drives. These are intelligent, compact, extremely dense storage units, where each is capable of holding a large numbers of disk drives in a small rack space (EIA-standard rack units).
- **Fibre Channel Adapters and FC-AL modules** provide high speed routing of data and enable granular and potentially massive connectivity to hosts and to the drive chassis.
- **Storage System Service Processor** (SP) provides the remote error detection and reporting capabilities that support diagnostic and maintenance activities involving HP 3PAR Storage systems. In general, one SP is required per storage system.

Figure 1 (page 6) and Figure 2 (page 7) show the front and rear views of a fully populated 2M (40U) 3PAR cabinet with the various components installed:

Figure 1 The Front of an S-Class or T-Class HP 3PAR Storage System

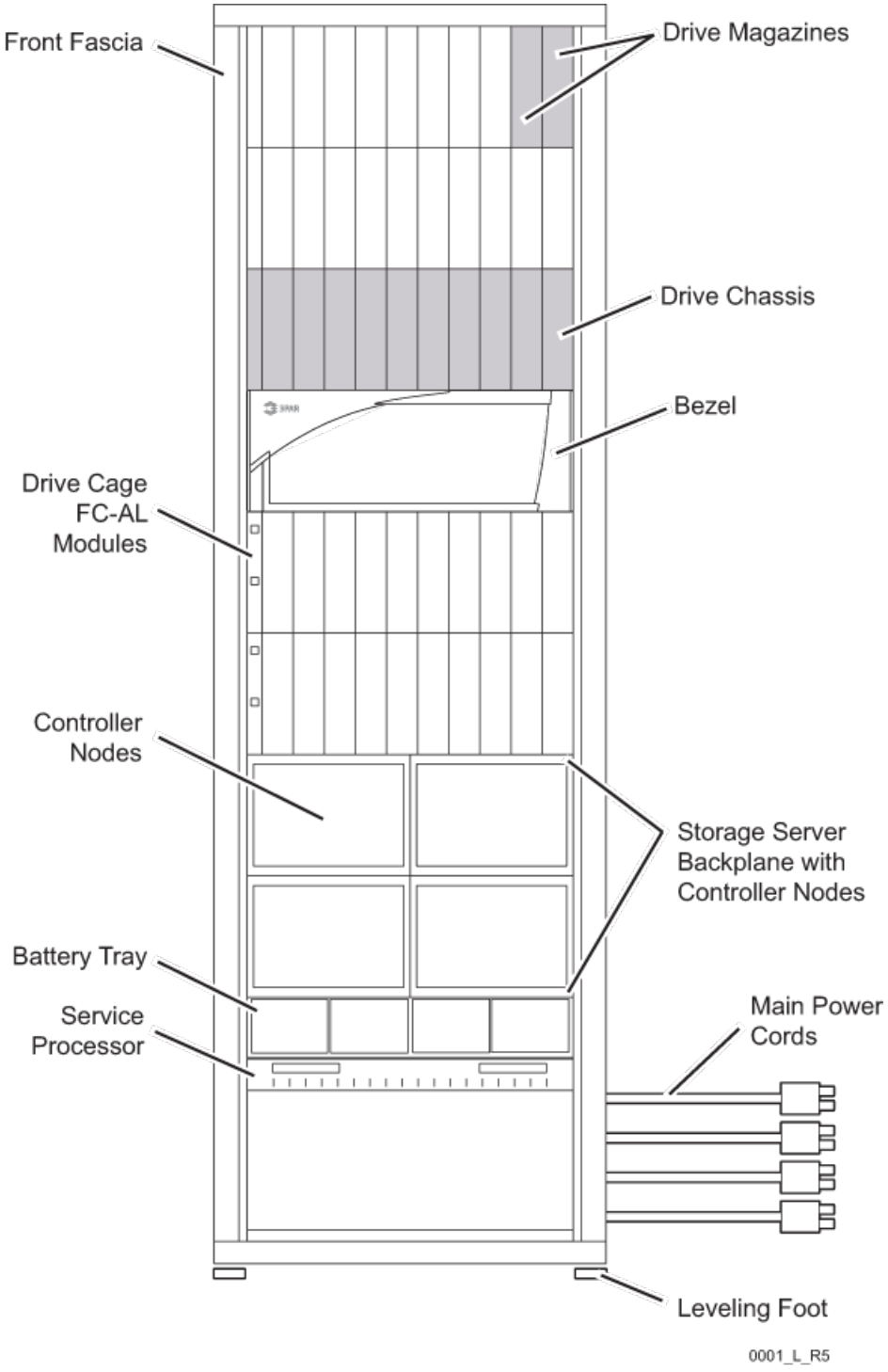
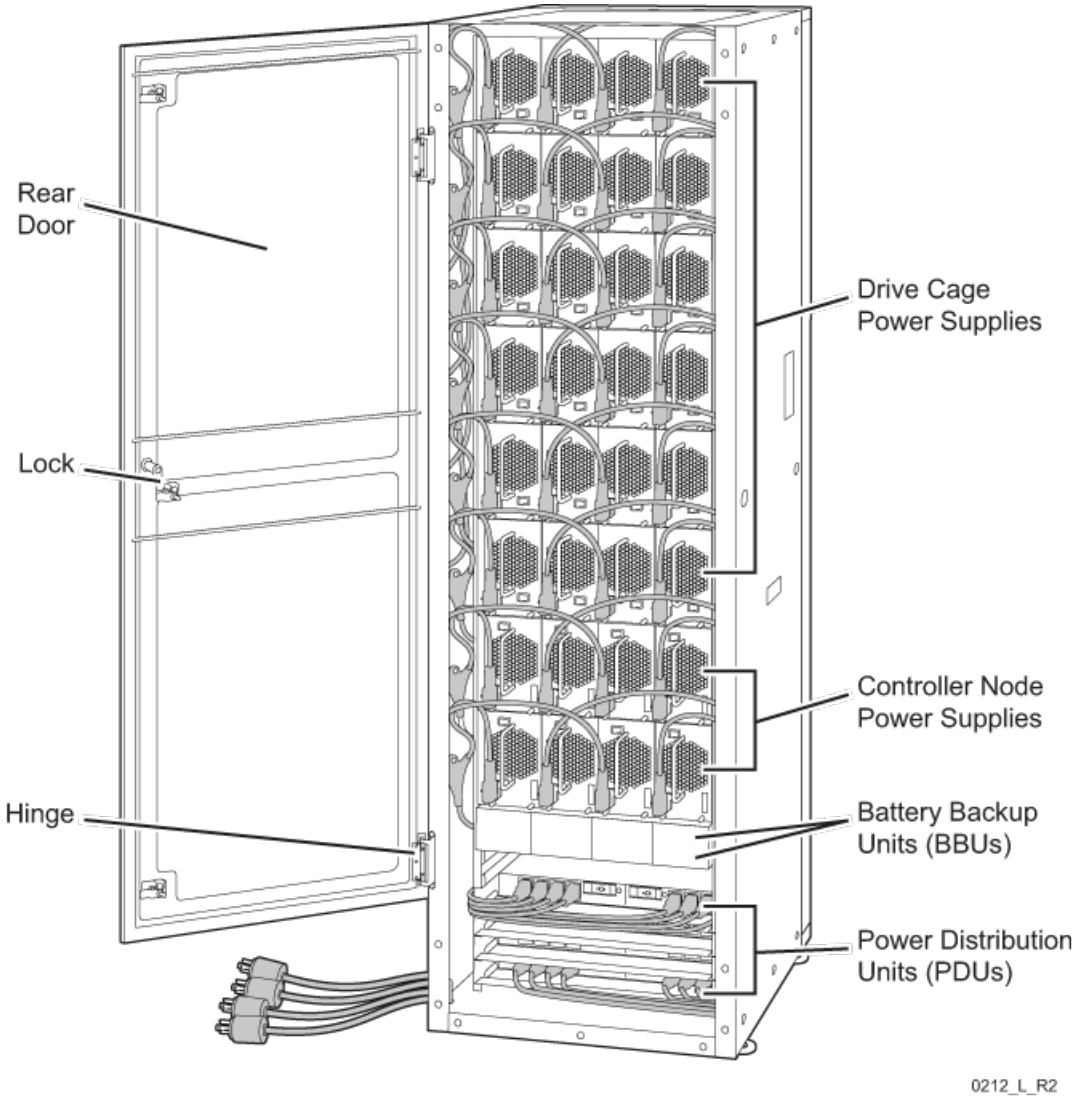


Figure 2 The Rear View of an S-Class or T-Class HP 3PAR Storage System



S400/S800 HP 3PAR Storage System Specifications

HP 3PAR S400 and S800 Storage systems accommodate up to four or eight controller nodes, respectively. The maximum number of supported drive chassis varies according to the number of controller nodes utilized by the system, the number and type of Fibre Channel adapters that are installed, and the drive chassis connection method being used.

Physical Specifications

The following table lists system specifications for the S-Class HP 3PAR Storage systems. These specifications are subject to change without notice.

Table 1 S400/S800 Storage System Physical Specifications

S400/S800 Storage System Physical Specifications		
2-Meter Cabinet		
Dimensions (width x height x depth)	23.8 x 76.4 x 36 in.	60.5 x 194.1 x 91.4 cm
Service Clearance	30 in. (76.2 cm), front and back	
Weight (not populated)	485 lbs.	220 kg
Maximum Weight (fully populated)	1,970 lbs.	893.6 kg

Table 1 S400/S800 Storage System Physical Specifications *(continued)*

S400/S800 Storage System Physical Specifications		
Maximum Weight per leveling foot	492.5 lbs.	223.4 kg
Maximum Load per leveling Foot	157 lbs/sq. in.	11.0 kg/sq. cm
Component Weights		
S400 Base Configuration	731 lbs.	331.6 kg
S800 Base Configuration	792 lbs.	359.2 kg
2 Controller Nodes (fully populated)	160 lbs.	72.5 kg
Drive Chassis (fully populated)	175 lbs.	79.4 kg
Service Processor	28 lbs.	12.7 kg

Capacity Specifications

The following table lists system capacity and configuration details for the S-Class Storage systems.

Table 2 S400/S800 Storage System Capacity Specifications

Feature	S400	S800
Number of controller nodes	2 or 4	2, 4, 6, or 8
Control Cache	4-16 GBs	4-32 GBs
Data Cache	24-32 GBs	24-64 GBs
Fibre Channel host ports (four-port adapters) *	0-64 (direct connect) 0-48 (fabric connect)	0-128 (direct connect) 0-96 (fabric connect)
Number of drives [1]	16-640	16-1,280
Raw capacity (approximate) [1]	2.3-300 TB	2.3-600 TB
Architectural maximum number of drives	3,200	6,400
RAID levels	RAID 0, 6, 10, 50	RAID 0, 6, 10, 50
RAID 5 data to parity ratios	2:1, 8:1	2:1, 8:1
Drive capacities (GB approximate)[1]	146 15K FC, 300 15K FC, 400 FC, 450 15K FC, 1 TB NL	146 15K FC, 300 15K FC, 400 FC, 450 15K, 1 TB NL
Number of drive chassis[2]		
• DC1	1–32	1–64
• DC2	1–16	1–32
Energy consumption efficiency[3]	not available.	0.148 (Based on a host-maximized system configuration using 450 GB drives.)

[1] Levels, ratios, and capacities all mixable within the same storage system. 1 GB=1,000,000,000 bytes.

[2] A single drive chassis holds up to 40 drives in 4U of space within an EIA-standard rack.

[3] Japan Green Law statement of compliance: The energy consumption efficiency value has been calculated per requirements for Category-G Magnetic Disk Drive Units by dividing the power consumption, measured according to the definition in the Law Concerning the Rational Use of Energy, by the storage capacity defined in the Energy Conservation Law. The efficiency value is based on a host-maximized S800 configuration using 147GB drives.

T400/T800 HP 3PAR Storage System Specifications

HP 3PAR T400 and T800 Storage systems accommodate up to four or eight controller nodes, respectively. The maximum number of supported drive chassis varies according to the number of controller nodes utilized by the system, the number and type of Fibre Channel adapters that are installed, and the drive chassis connection method being used.

Physical Specifications

The following table lists system specifications for the T-Class Storage systems. These specifications are subject to change without notice.

Table 3 T400/T800 Storage System Physical Specifications

T400/T800 Storage System Physical Specifications		
2-Meter Cabinet		
Dimensions (width x height x depth)	23.8 x 76.4 x 36 in.	60.5 x 194.1 x 91.4 cm
Service Clearance	30 in. (76.2 cm), front and back	
Weight (not populated)	485 lbs.	220 kg
Maximum Weight (fully populated)	1,970 lbs.	893.6 kg
Maximum Weight per leveling foot	492.5 lbs.	223.4 kg
Maximum Load per leveling Foot	157 lbs/sq. in.	11.0 kg/sq. cm
Component Weights		
T400 Base Configuration	731 lbs.	331.6 kg
T800 Base Configuration	792 lbs.	359.2 kg
2 Controller Nodes (fully populated)	160 lbs.	72.5 kg
Drive Chassis (fully populated)	175 lbs.	79.4 kg
Service Processor (SuperMicro)	10 lbs.	4.5 kg
Service Processor (SuperMicro II)	28 lbs.	12.7 kg

Capacity Specifications

The following table lists system capacity and configuration details for the T-Class Storage systems.

Table 4 T400/T800 Storage System Capacity Specifications

Feature	**T400**	**T800**
Number of controller nodes	2 or 4	2, 4, 6, or 8
Control Cache	8 - 16 GBs	8-32 GBs
Data Cache	24-48 GBs	24-96 GBs
Fibre Channel host ports (four-port adapters)[1]	0-64	0-128
Number of drives[1]	16-640	16-1,280
Raw capacity (approximate) [1]	2.3-400 TB	2.3-800 TB
Architectural maximum number of drives	3,200	6,400
RAID levels	RAID 0, 6, 10, 50	RAID 0, 6, 10, 50
RAID 5 data to parity ratios	2:1, 8:1	2:1, 8:1

Table 4 T400/T800 Storage System Capacity Specifications *(continued)*

Feature	T400	T800
RAID 6 data to parity ratios	6:2, 14:2	6:2, 14:2
Drive capacities (GB approximate)[1]	50 GB SSD, 146 GB 15K FC, 300 GB 15K FC, 400 GB FC, 400 GB SSD, 450 GB 15K FC, 600 GB FC, 1 TB NL, 2 TB NL	50 GB SSD, 146 GB 15K FC, 300 GB 15K FC, 400 GB FC, 400 GB SSD, 450 GB 15K FC, 600 GB FC, 1 TB NL, 2 TB NL
Number of drive chassis[2]		
DC4	2–16	2–32
Energy consumption efficiency[3]	not available	0.452

Power and Heat Specifications

The following table lists the electrical power requirements for the T-Class Storage systems.

Table 5 T-Class Storage System Power Requirements

2 Meter Cabinet			
	Max. Watts per Cabinet (fully populated)		9,984[1]
	Max. BTUs/hour per cabinet (fully populated)		34,066.82
	Input Voltage (VAC)		200 - 240
	Frequency (Hz)		50 - 60
	Circuit Breaker Max		30A per PDU (de-rated to 24A)
	Drive Chassis (no magazines)		200
	Power Connectors		(4) L6-30P (North America and Japan) (4) IEC-60309 Plug (EU and Korea)
Node Pair (fully populated)		**Transactional**[2]	**Idle**
	Watts	705	630
	BTUs/hour (fully populated)	2,406	2,150
Drive Chassis (no magazines)		200	200
Drive Magazine [3]		**Transactional**	**Idle**
	4 x 50 GB SSD Drive Magazines		
	Watts	14	12
	BTUs/hour	48	41
	4 x 146 GB FC Drive Magazines		
	Watts	76	57
	BTUs/hour	259	195
	4 x 300 GB FC Drive Magazines		
	Watts	60	52
	BTUs/hour	205	177
	4 x 400 GB FC Drive Magazines		
	Watts	61	47

Table 5 T-Class Storage System Power Requirements *(continued)*

	BTUs/hour	208	160
	4 x 450 GB FC Drive Magazines		
	Watts	88	57
	BTUs/hour	300	194
	4 x 600 GB FC Drive Magazines		
	Watts	73	65
	BTUs/hour	249	222
	4 x 1 TB NL Drive Magazines		
	Watts	47	32
	BTUs/hour	160	109
	4 x 2 TB NL SATA Drive Magazines		
	Watts	42	32
	BTUs/hour	143	111
Service Processor			
	SuperMicro Watts	260	
	SuperMicro BTUs/hour (fully populated)	1370 BTUs/hr.	
	SuperMicro II Watts	280	
	Supermicro II BTUs/hour (fully populated)	955 BTUs/hr.	

[1] Theoretical maximum based on branch circuit capacity.

[2] Under maximum load.

[3] Up to 10 drive magazines (40 drives) per drive chassis.

NOTE: All calculations in Table 5 (page 10) are based on *fully populated* components; for example, a fully populated drive chassis contains 40 disks. Specifications are not provided for partially populated drive chassis because different drives and magazine types have varying current requirements and can be installed in a variety of different combinations. Therefore, only the maximum, fully loaded configuration is cited.

NOTE: The total system peak inrush current on system startup can vary depending on the system configuration but is mitigated through a staggered (sequenced) drive spin-up and by distributing the load equally unless there is a failure on a given line.

Environmental Specifications

The following table lists the environmental specifications for the T-Class Storage systems.

Table 6 Environmental Specifications for HP 3PAR Storage systems

Specification	Value
Altitude Operating Non-operating	0 –10,000 ft (3,048 m) 0 –40,000 ft (12,192 m)
Ambient temperature Operating	50 –104° F (10–40° C)

Table 6 Environmental Specifications for HP 3PAR Storage systems *(continued)*

Specification	Value
Non-operating	0–3,000 ft (914.4 m) 50 –95° F (10 –35° C) 3,000–10,000 ft (914–3,048 m) –40 –203° F (–40– 95° C) 0–40,000 ft (0–12,192 m)
Temperature gradient Operating Non-operating	 18° F/hr (10° C/hr) 18° F/hr (10° C/hr)
Relative humidity	20 – 80 percent non-condensing, maximum gradient 10 percent per hour

NOTE: Refer to "Structural/Environmental Considerations" (page 18) for complete details.

Cable Specifications

The following table lists the types of cables commonly required for storage system installation.

Table 7 Required Cables

Cable Type	Connector Type
Ethernet (Category 5) 3 cables minimum with 2 static IPs	RJ-45
Multi-mode Fibre Channel	LC-LC

The following table shows the typical Fibre Channel cable lengths required for a given type of connection:

Table 8 Fibre Channel Cable Usage Guidelines

Cable Length	Used for...
2 m	Drive chassis to controller node connections in the same side of the same cabinet (for example, an even-numbered drive cage to an even-numbered node).
4 m	Drive chassis to controller node connections across the same cabinet (for example, an even-numbered drive cage to an odd-numbered node).
10 m 50 m 100 m	Cabling between cabinets. Always round up to the nearest size.

The following table shows the maximum supported Fibre Channel cable length based on the cable size and port speed.

Table 9 Cable Limitations for Fibre Channel Host Connectivity

Cable Size	Speed	Cable Length Limit
62.5 micron	2 Gbps	100 meters
62.5 micron	4 Gbps	70 meters
50 micron	2 Gbps	300 meters
50 micron	4 Gbps	150 meters

NOTE: Refer to "Network, Cabling and Connectivity" (page 37) for more details on cable requirements and configurations.

2 General Site Planning

This chapter provides general recommendations for physical planning and site preparation for installation and operation of the HP 3PAR S-Class and T-Class Storage systems.

General Planning

Successful installation of HP 3PAR Storage systems requires careful planning and supervision in collaboration with authorized HP representatives. Proper planning will help provide for a more efficient installation and greater reliability, availability, and serviceability.

Customer Responsibilities

When planning and preparing for the installation of HP 3PAR Storage systems at a customer site, the customer assumes the following responsibilities:

- Providing suitable space for unpacking, installing and operating the servers
- Maintaining the proper environmental conditions for the servers
- Providing adequate power facilities for the servers
- Supplying the network connections and external cabling required by the servers
- Enabling the appropriate HP remote support strategy

The customer is responsible for providing a suitable space and environment for the installation of the HP 3PAR Storage systems. All pre installation activities should be scheduled and completed before the equipment is delivered.

Electronic equipment has special packing for shipping and receives special handling during transportation; the manufacturing environment and packing for shipping are the responsibilities of 3PAR. It is the customer's responsibility to ensure that space is available for unpacking and installing the new equipment upon delivery.

For optimal performance at a specific location, HP 3PAR Storage systems require controlled environmental conditions that can best be facilitated through raised flooring and under-floor air conditioning. It is the customer's responsibility to monitor this environment to ensure continued conformance with the recommended environmental specifications. Refer to "Structural/Environmental Considerations" (page 18) for specific information concerning server room environments.

Adequate power is necessary for the reliable functioning of electronic equipment and for the safety of the customer's installation. The customer is responsible for procuring, installing, and maintaining adequate power to the equipment. Refer to "Power Requirements" (page 28) for input electrical power and grounding requirements.

Planning for Installation

The following are suggested site planning considerations to be completed prior to the delivery and installation of the selected HP 3PAR Storage system.

- Prepare a preliminary layout of the subsystem installation.
- Review the power and the heating, ventilation, and air-conditioning (HVAC) requirements.
- Order any additional support equipment indicated by the power and HVAC review.
- Work with the appropriate HP representative to ensure that all system units in the specified configuration and all cables of the required length have been ordered.
- Make a final layout of the installation and review the layout with your HP representative.
- Select key personnel and arrange for training with your HP representative.

- Verify that electrical service wiring has been installed at the server's predetermined location. Refer to the respective product specifications for detailed requirements.
- Verify of any additional support equipment is properly installed and operational.

At installation time, the HP representative will supervise the delivery and unpacking of the equipment. The representative must also review the crate with the customer to check that the shipping crates have not been tampered with. When unpacking the equipment, verify the shipment is correct and all equipment was delivered. Refer to the packing slip and the SKUs with the shipment.

NOTE: No part of the installation, from unloading the crated server from the delivery vehicle to unpacking and placement, should be performed without the supervision of a HP representative. This is a fundamental requirement for the safety of both the equipment and personnel.

Preparing a Pre-Installation Site Planning Guide

Prior to installation, the customer will complete a systems planning document such as the *HP 3PAR Systems Assurance and Pre-Site Planning Guide* in cooperation with the local HP Sales Representative or HP Systems Engineer.

The systems planning guide is a working document that contains the following information:

- Contact information for customer personnel and for HP technical sales, support, and service personnel
- Implementation project plan
- Configuration information for the HP 3PAR Storage system to be installed, including system configuration diagrams
- Shipping and delivery details and requirements
- Management workstation, SP, and network information
- Description of the customer environment
- Volume and RAID level planning information
- Customer training project plan
- Additional notes and comments regarding installation
- Current support matrix
- System technical specifications
- Systems Acceptance Certificate
- Customer Services installation checklist

Common Criteria Evaluated Configurations

The HP 3PAR StoreServ 10000 Storage systems using HP 3PAR OS 3.1.2.MU1 have been evaluated to conform to Common Criteria Evaluation Assurance Level 2 when configured accordingly. For more information about the Common Criteria and the specific of the evaluated configuration see the *HP 3PAR OS Common Criteria Administrator's Reference*.

Shipping and Acclimatization Requirements

Safe transport of HP 3PAR Storage systems requires the appropriate shipping containers. A separate crate holds each storage system cabinet while drive magazine shipping containers hold a maximum of thirty drive magazines each.

Shipping Requirements

A separate shipping container holds each storage system cabinet while drive magazine shipping containers hold a maximum of 16 drive magazines each. Customers should examine the delivered

package for obvious damage or signs of tampering and notify both HP and the carrier of any issues.

Shipping container measurements are as follows:

- Cabinet crate (one per 2M rack cabinet): Height: 83 inches (210.8 cm) x Width: 42 in. (106.7 cm) x Depth: 51 in. (129.5 cm)

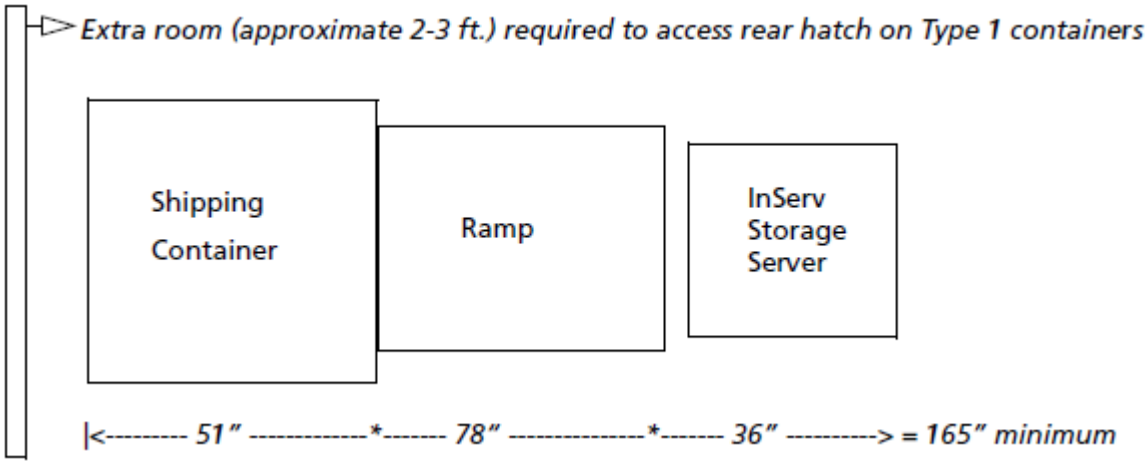
  Approximate shipping weight: 1172 lb (531.6 kg)

- Drive magazine container (one per 16 drive magazines): 38 in. (96.5 cm) x 34 in. (86.4 cm) x 28 inc. (71 cm)[1, 1]

  Approximate shipping weight: 78 lb (35 kg)

When the equipment arrives, you must make sure that there is enough room to unload and unpack the server. The specific amount of space you will need to unpack the server is based on the dimensions of the container, the ramp and the room required to access the server so that it can be moved to its placement destination. You will need to reserve enough space to accommodate the crate, the ramp and the Storage System as depicted in the following illustration:

Figure 3 Total Area Required for Unpacking a storage system


Extra room (approximate 2-3 ft.) required to access rear hatch on Type 1 containers
Shipping Container
Ramp
InServ Storage Server
|<-------- 51" ----------*------- 78" ----------*------- 36" ----------> = 165" minimum

The specific amount of space you will need to unpack the server is based on the dimensions of the container, the ramp and the room required to access the server so that it can be moved to its placement destination. See and "Cabinet Shipping Container" (page 15) for calculating the specific dimensions of the shipping crate.

NOTE: See "Structural/Environmental Considerations" (page 18)"Providing for Service Access" (page 24) for more information on placing the storage systems and reserving room for service access.

Cabinet Shipping Container

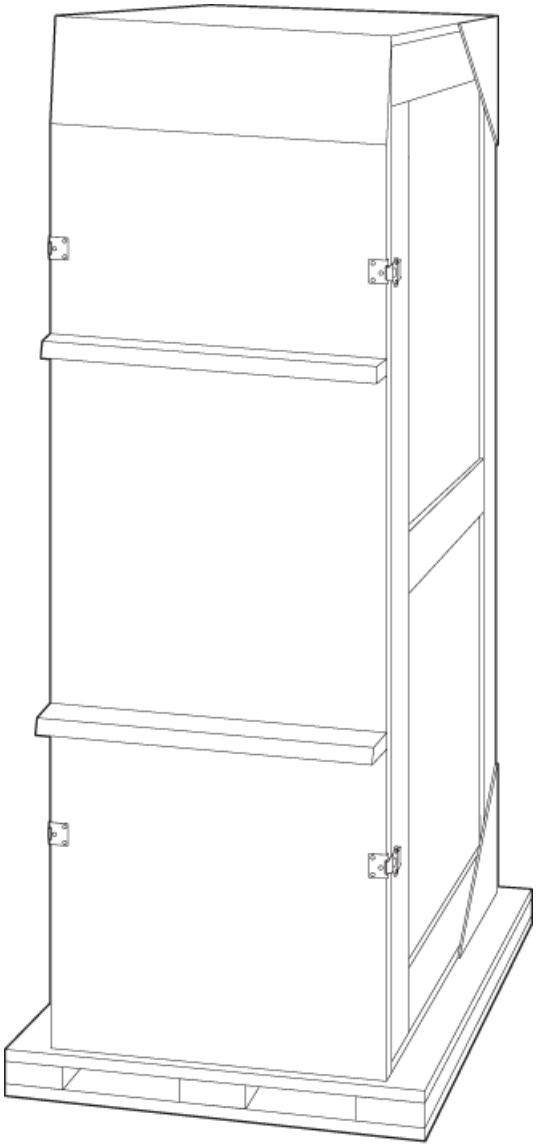
Measurements for the shipping container are as follows:

- Cabinet crate (one per cabinet): Height: 83 inches (210.8 cm) x Width: 42 in. (106.7 cm) x Depth: 51 in. (129.5 cm)
- Open ramp length: 76 inches (193 cm)
- Approximate shipping weight: 2000 lb. (907 kg)

The following illustration shows the front view of the shipping container:

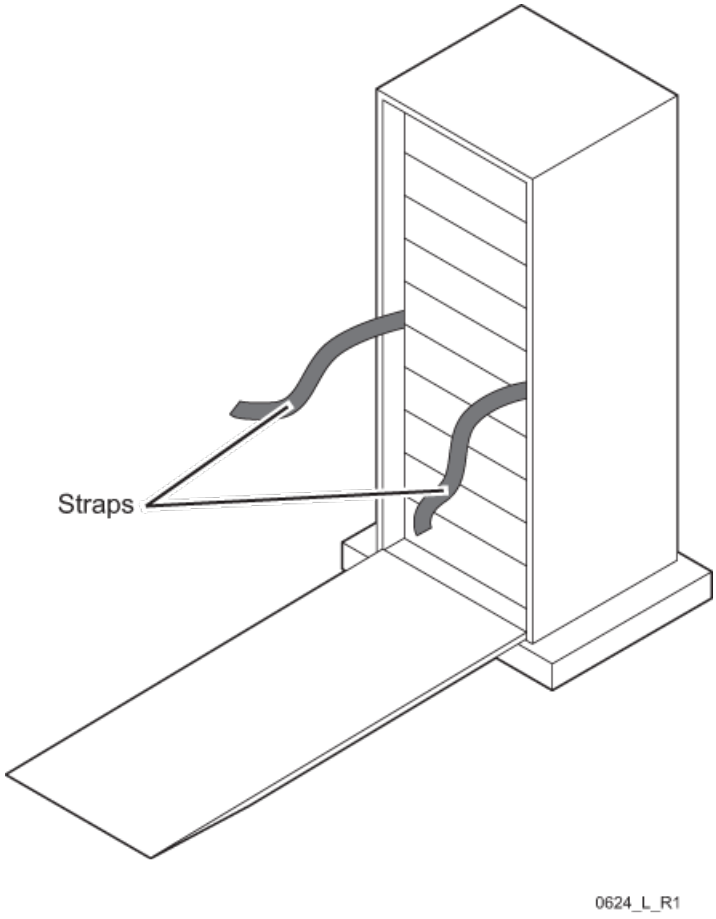
1. For systems shipped internationally and for systems with fewer than sixteen drive magazines. The magazines are shipped in boxes and each box contains three magazines.

Figure 4 Front View of the Cabinet Shipping Container



The equipment is removed from the front of the container by pulling on two straps that wrap around the cabinet. The following illustration shows the front view of the container with the ramp down and the straps exposed:

Figure 5 Front View of the Container with Ramp Down



Acclimatization

HP 3PAR Storage systems shipped or stored at extreme temperatures may require time to adjust to operating temperatures before starting up. The maximum acceptable rate of temperature change for a non-operating system is 18° F/hr (10° C/hr). The storage system requires time to acclimatize to new environmental conditions before being powered on. During that time, it is possible to proceed with the physical installation of the storage system; however, the storage system may need at least 24 hours to acclimatize to a new environment prior to completing the full system installation. If condensation is present even after the 24 hour acclimatization period, it is necessary to wait until all condensation has evaporated before completing the power-on sequence.

3 Structural/Environmental Considerations

You should consider the following when choosing or designing your facilities for HP 3PAR Storage systems:

- Equipment location and layout that allows efficient use, easy maintenance, and future expansion.
- Facility construction that provides a suitable operating environment, sufficient power and adequate protection from fire, contamination, or other hazards.
- Suitable temperatures and appropriate air quality that is free from environmental contaminants.

The customer is responsible for maintaining the room environment according to the recommended specifications. Environmental conditions for the room and under the floor must be maintained within the acceptable limits to prevent any adverse impact on performance and reliability. The installation environment should be monitored on a regular basis to ensure continued conformance to recommended environmental specifications. The customer may request assistance from a HP representative to help in analyzing the site location and environment to make appropriate recommendations.

Establishing the Proper Foundation

As with any electronic equipment that generates heat, the HP 3PAR Storage systems must be housed in a cool environment. Common techniques for maintaining an optimal operating environment generally incorporate the use of raised flooring and alternating hot and cold aisle layouts.

Benefits of Raised Floors

While not required, HP 3PAR Storage systems can be installed on raised floors with under the floor air cooling. Raised floors will allow cables to be located safely beneath the floor. If the facility does not have raised floors and under the floor air cooling, temperature and airflow must be in compliance with the recommended specifications.

The raised floor system should consist of removable panels or panels on a stringer grid system, supported by adjustable steel pedestal assemblies. The raised floor can be constructed of steel, aluminum, or fire-retardant wood. The purpose of the raised floor system is to:

- Permit space between floors to supply cooled air to the equipment.
- Support the total weight of the system and service area loading.
- Protect interconnecting cables and power receptacles.
- Allow for future layout changes with minimum cost.
- Provide safety for personnel.

Raised Floor Requirements

There are additional structural considerations when installing HP 3PAR Storage systems in environments with raised flooring.

NOTE: This section considers a standard raised floor construction that consists of the following: 24 in. (61 cm) square or 24 in. (61 cm) X 36 in. (91.5 cm) panels, steel or aluminum stringers, and pedestal supports attached to an underlying concrete slab or steel deck.

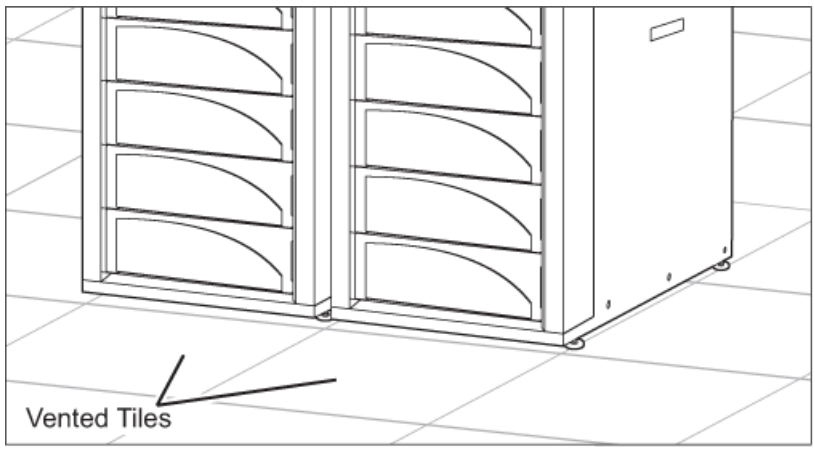
Prior to installation, verify the raised floor at the operating site meets the specifications described in Table 10 (page 19).

Table 10 Raised Floor Specifications

Specification	Value
Flatness tolerance Per 10 ft (3 m) span Overall	 Less than 0.06 in. (1.5 mm) Less than 0 .10 in. (2.5 mm)
Deflection Dynamic Permanent	 Less than 0.15 in. (3.8 mm) Less than 0.02 in. (0.5 mm)
Pedestal assembly load Axial Side	 At least 5,000 lb (2,268 kg) At least 30 ft-lb (40.7 N-m)

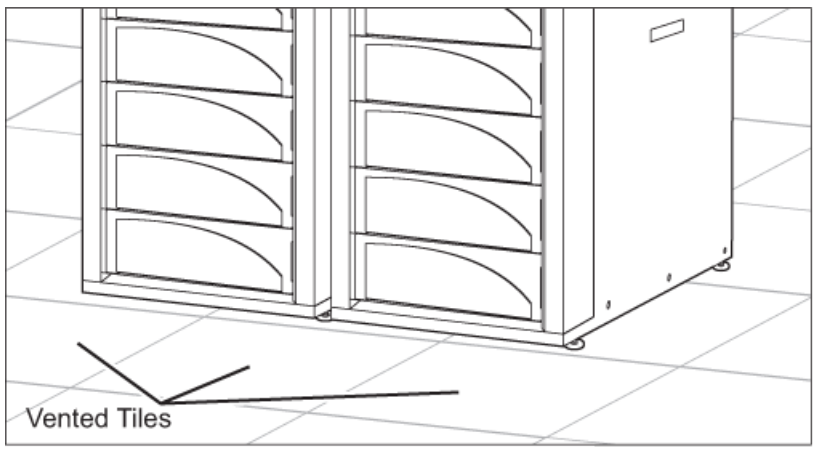
Placing each storage system cabinet across two floor tiles is strongly recommended. It is also strongly recommended that a vented floor tile be placed in front of each cabinet. Figure 6 (page 19) shows two storage systems side-by-side, each resting across two floor tiles.

Figure 6 Adjacent Cabinets Placed Across Two Floor Panels Each (Recommended)



When necessary, a storage system can also rest across four floor tiles, with two adjacent storage systems resting partially on the same tiles so that they use a total of six tiles, as shown in Figure 7 (page 19). Again, it is strongly recommended to have vented tiles in the front.

Figure 7 Storage Systems Resting Partially on the Same Floor Panels



However, before placing a cabinet on floor tiles shared with other cabinets or equipment, first verify that the floor panels can tolerate the weight and pressure loads. Maximum weight and pressure loads for storage systems are provided in Table 11 (page 20).

When placing cabinets with their weight shared by the same panels as shown in Figure 7 (page 19), verify that each panel can tolerate the maximum weight per panel, calculated as follows:

$$\frac{\text{weight cabinet } x + \text{weight cabinet } y}{2}$$

where cabinet *x* and cabinet *y* are cabinets or equipment resting partially on the same floor panel.

Weight and Pressure Loads

Depending on the configuration, an HP 3PAR Storage system can weigh up to 2,000 lb (907 kg). Table 11 (page 20) provides maximum weights and pressure loads per leveling foot for HP cabinets. Use these values to approximate the structural support required by a storage system cabinet.

Table 11 Maximum Weights and Pressure Loads

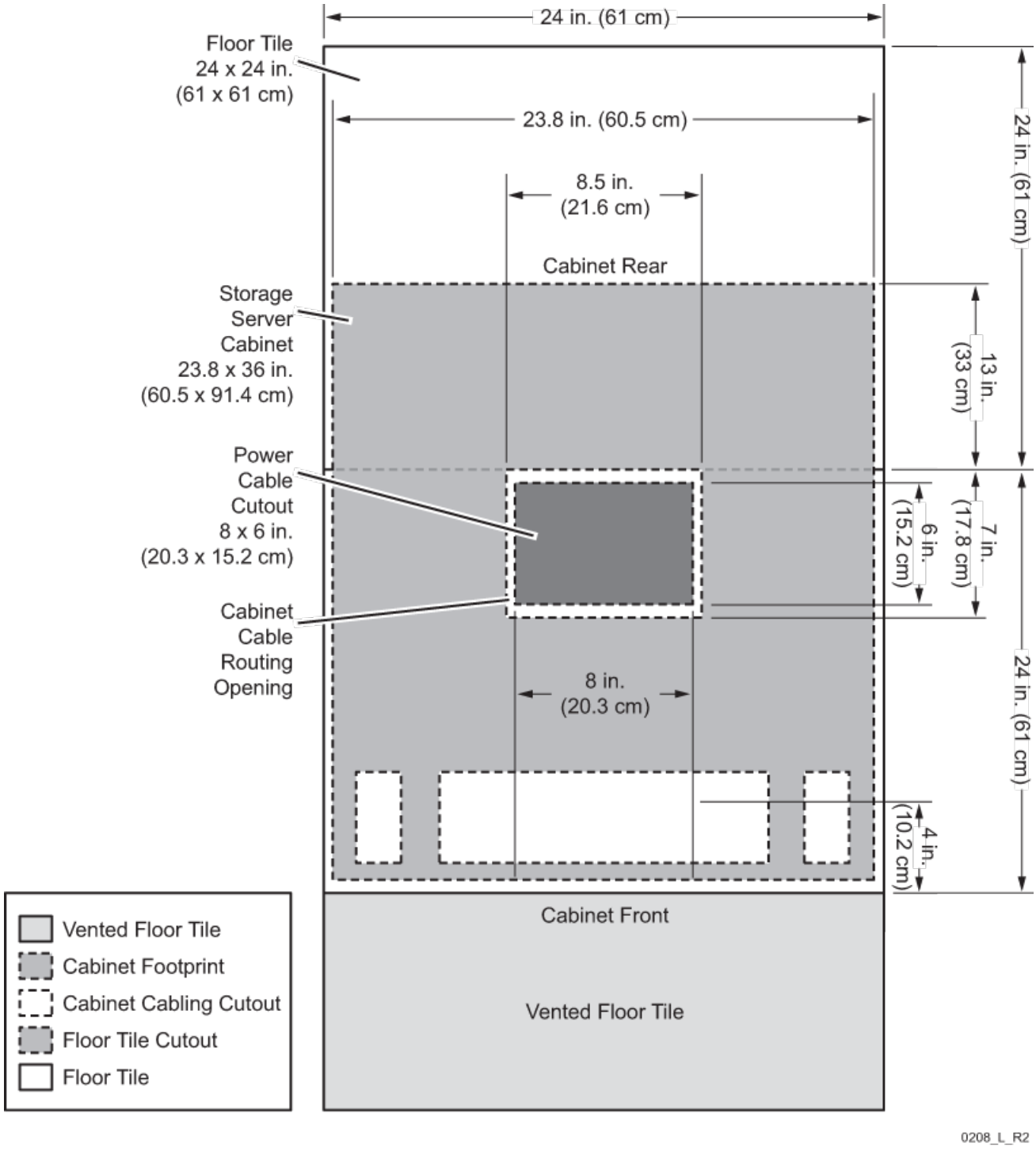
Cabinet Size	Maximum Weight	Maximum Weight Per Leveling Foot	Maximum Load Per Leveling Foot
2M (40U)	2,000 lb (907.2 kg)	500 lb (226.8 kg)	157 lb/sq in. (11.0 kg/sq cm)

NOTE: The table uses nominal numbers to simplify calculations.

Tile Cutout Specifications

Figure 8 (page 21) shows the recommended tile cutout specifications for storage system cabinets.

Figure 8 Tile Cutout Specifications



WARNING! To prevent potential collapse, loaded floor panels that have cutouts to facilitate cable routing may require additional reinforcement.

Anchoring Dimensions for HP 3PAR Storage Systems

For some installations, you may want to anchor HP 3PAR Storage systems to the floor for better stability, especially in active seismic locations. While HP does not supply, or specifically recommend any particular anchoring solution, there are several third-party anchoring kits that can be procured for this purpose. Figure 9 (page 22), Figure 10 (page 22) and Figure 11 (page 22) provide the required dimensions for the base of the HP 3PAR Storage system cabinet:

Figure 9 Front View Dimensions for the HP 3PAR Storage System

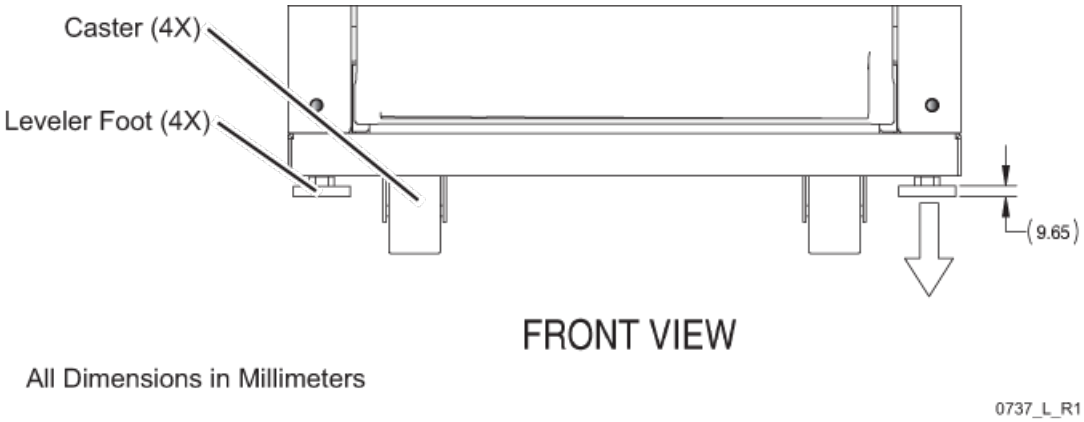


Figure 10 Side View Dimensions for the HP 3PAR Storage System

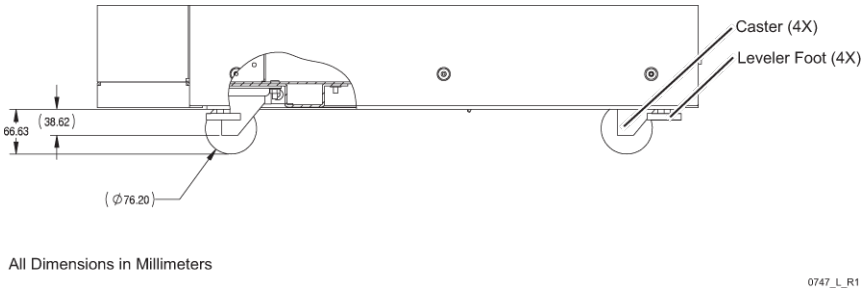
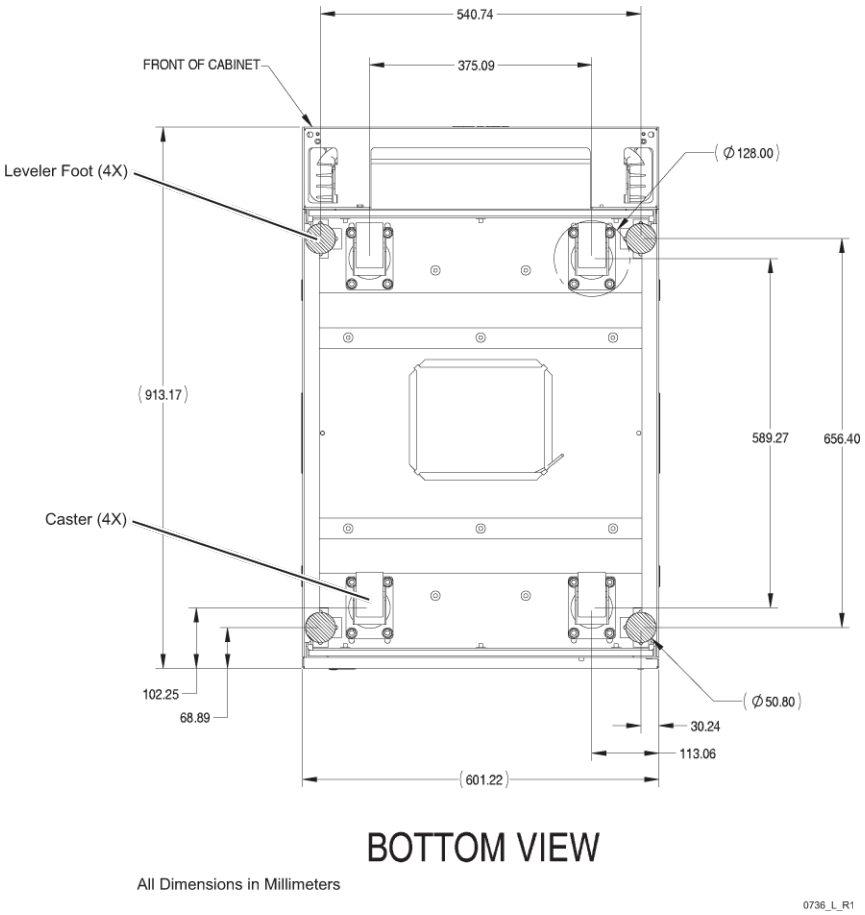


Figure 11 Bottom View Dimensions for the HP 3PAR Storage System



Additional Flooring Recommendations

Consider the following recommendations for raised floor installations:

- The flooring should be high enough to allow under the floor routing of cables and specified airflow to system air intakes. The recommended minimum floor clearance is 30.5 cm (12 in). An additional 7.6 cm (3 in) should be allowed for cables and connectors. A floor clearance of 46 cm (18 in) is recommended for new construction.

  Additional panel support may be required to restore the structural integrity of a raised floor panel that has been cut for air opening, cable entry, and so on. Raised floors without stringers may also require lateral support to prevent floor tile movement.

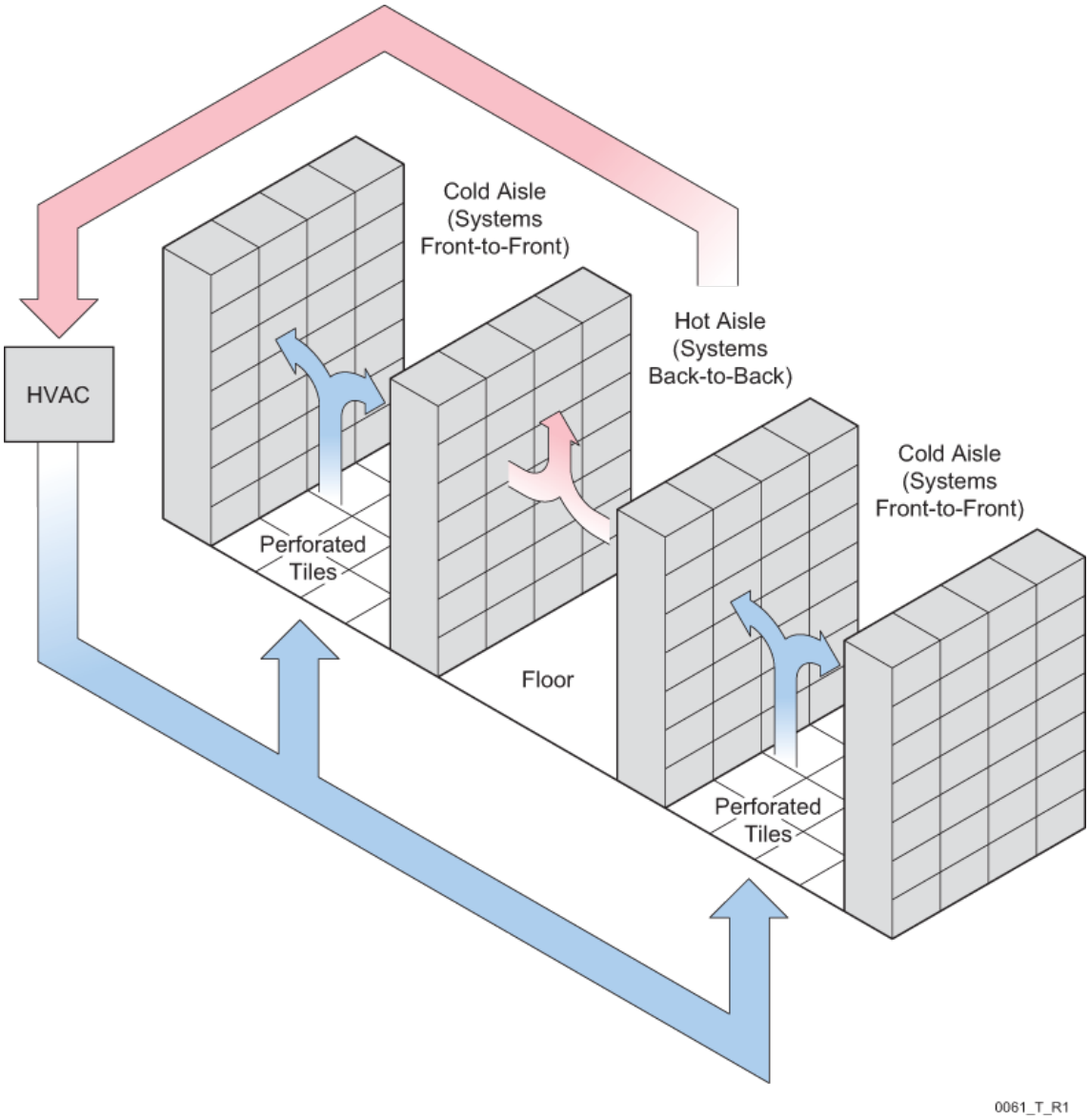
  The finished floor-to-ceiling height should be a minimum of 2.44 meters (8 feet).

- The sub-floor must have adequate drainage to prevent flooding and trapping of water beneath the raised floor. Cement should be sealed to prevent the formation of particulates.
- To avoid an electrical hazard when using a metallic floor, no metal or conductive material should be exposed to the walking surface.
- Sharp edges must be eliminated on all floor cutouts where cables pass. For wood or similar core material, all cut edges must be covered with metal or plastic clips or grommets so that none of the core is exposed (see NFPA 75 requirements).
- Asphalt tiles are not recommended because they produce dust that may cause equipment malfunction.
- Carpeting is not recommended because it produces and holds dust, and can contribute to the buildup of electrostatic charges on people and equipment.
- Most raised floors are composed of 60 cm (International/Metric) or 24 in. (Domestic/American Standard) square floor tiles. The maximum panel size should not exceed 60 by 90 cm (International/Metric) or 24 by 36 in. (Domestic/American Standard). The panels should have a flame spread rating of 15 or better when tested according to the American Society for Testing and Materials (ASTM) Standard E 84.
- Provide a conductive path to ground from the metallic raised floor structure through the metallic supporting structure or separately from each tile.
- Ensure the maximum resistance for floor surface material is 20 gigohms, measured between the floor surface and building ground.
- The resistance between adjacent tiles should not be less than 150 kilohms when measured between any points on the floor, spaced 91.5 cm (36 in) apart.
- Maintenance of antistatic floor covering should be performed according to supplier's recommendations.
- The floor covering can contribute to a buildup of high static electrical charge. To minimize static charge:

Hot-Aisle/Cold-Aisle Cooling Layout

Air flows through the HP 3PAR Storage systems from the front to the rear, so when installing multiple servers in the same room, consider facing each pair of servers in a front to rear configuration. This allows cool air to be circulated through the rows in the front of the servers and exhausted through rows in back. This is referred to as a hot-aisle/cold-aisle layout and eliminates the direct transfer of hot exhaust air from one server into the intake air of another as shown in Figure 12 (page 24).

Figure 12 Hot-Aisle/Cold-Aisle Layout



Form rows of racks or cabinets perpendicular to air conditioners. This formation facilitates an unobstructed flow of heated air down the aisles to the air conditioner return ducts. Heated air must not be forced to travel over or between the cabinets to get to the air conditioner return ducts. Doing so could heat the air in the cold aisles. Ensure that any free-standing equipment does not allow air to flow between the hot and cold aisles.

A cold aisle has perforated floor tiles or grates that enable cold air to rise from the raised floor whereas the hot aisle has no tiles or grates so that hot air and cold air do not mix. Seal cable cutouts in both hot aisles and cold aisles to increase under the floor pressure and to eliminate cold or hot air redirection. To further optimize the airflow in hot and cold aisles, install blanking panels at the front of all unused cabinet spaces so that hot air does not recirculate to the system's cold air inlet.

Providing for Service Access

HP 3PAR Storage systems are housed in 2M (40U) cabinets that measure 76.4 in. (194 cm) x 23.8 in. (60.5 cm) x 36 in. (91.4 cm). Cabinets feature locking rear doors and removable side panels and fascias to improve access while installing, cabling, and servicing components.

When establishing an operating site for an HP 3PAR Storage system, provide for adequate access to cabinets by following the access area recommendations in Table 12 (page 25).

NOTE: The S800 and T800 Storage systems have circuit breakers located at both the front and rear of the system. It is necessary to maintain access to both the front and rear circuit breakers.

Table 12 Recommended Access Areas for 3PAR Cabinets

Cabinet Surface	Access Area During Operation
Front	36 in (91.4 cm)
Rear	30 in (76.2 cm)
Left and right sides	None

NOTE: HP cabinets do not require side access during operation. However, during installation, it is a good practice to allow 3 ft (91.4 cm) on one side of the cabinet in case it becomes necessary to remove a side panel. For instance, access through a side panel may be required for overhead power cable routing.

Meeting Environmental Conditions

For the HP 3PAR Storage systems, it is recommended that you maintain a controlled environment requiring a high degree of cleanliness, close control of temperature and humidity, and infrequent personnel access.

HP also recommends the installation site meet the specifications detailed in GR-63-CORE for office vibration.

△ **CAUTION:** The storage system operating environment must be free from continuous vibration and from dust and other environmental contaminants.

In addition, the operating site must comply with the following environmental specifications (Table 6 (page 11)):

Table 13 Environmental Specifications for HP 3PAR Storage systems

Specification	Value
Altitude Operating Non-operating	 0 –10,000 ft (3,048 m) 0 –40,000 ft (12,192 m)
Ambient temperature Operating Non-operating	50 –104° F (10–40° C) 0–3,000 ft (914.4 m) 50 –95° F (10 –35° C) 3,000–10,000 ft (914–3,048 m) –40 –203° F (–40– 95° C) 0–40,000 ft (0–12,192 m)
Temperature gradient Operating Non-operating	18° F/hr (10° C/hr) 18° F/hr (10° C/hr)
Relative humidity	20 – 80 percent non-condensing, maximum gradient 10 percent per hours

Maintaining the Optimal Temperature

The level of cooling required for the HP 3PAR Storage systems is quite different from the air-conditioning used in offices. Comfort air-conditioning systems are designed for the lower heat and higher moisture generated by the human body. In contrast, equipment has high heat output that is moisture-free (sensible heat). In comfort systems, sensible heat normally produces 60 to 70

percent of the load, whereas the dry heat of electronic equipment produces a sensible heat ratio of over 95 percent.

Prior to installation, verify that the operating site is equipped with a cooling system that can support all thermal emissions. Use the average and maximum thermal emissions of storage system components listed in Table 14 (page 26) to estimate the cooling requirements for an HP 3PAR Storage system based on a specific system configuration.

Proper site layout is critical to ensure the ambient temperature near the intake of the system does not rise beyond the system specifications. Exceeding the maximum ambient temperature for any period negatively affects the system's reliability and performance, and continued operation for extended periods under such conditions might actually cause the system to shut down.

△ **CAUTION:** Heated air from nearby equipment should not exhaust into the front of the HP 3PAR Storage system.

Table 14 Thermal Emissions of Storage System Components

Component (Fully Populated)	Average Thermal Emissions	Maximum Thermal Emissions
Controller node (pair)[1]	2,164 BTU/hr (545.3 Kcal/hr)	3,004 BTU/hr (757 Kcal/hr)
Drive chassis (single)	3,657 BTU/hr (921.6 Kcal/hr)	4,973 BTU/hr (1,253.2 Kcal/hr)
Drive chassis (pair)[2]	7,314 BTU/hr (1,843.2 Kcal/hr)	9,946 BTU/hr (2,506.4 Kcal/hr)

[1] Controller nodes can only be installed in pairs.

[2] HP 3PAR Storage systems require a minimum of two drive chassis; however, additional drive chassis can be installed individually.

HP 3PAR Storage systems can tolerate temperature and humidity fluctuations if the specified guidelines are understood and followed. Exposure to conditions outside the specified ranges may damage the system or its components.

Before a system is powered on, the air entering the subsystem must be clean and within the ranges specified for temperatures and humidity. The room humidity must be kept sufficiently low to prevent condensation on or within the subsystem, and must never exceed the limit specified in the subsystem environmental requirements tables, including transients. The server must never be exposed to conditions that could cause internal condensation to occur within the subsystem.

The air-conditioning units should have controls monitoring under the floor output that respond to 1° C (2° F) and 5 percent relative humidity. Humidification is normally required to replace moisture removed during the cooling process. The relative humidity for a subsystem equipment room should be set at 40 percent. This level is sufficient to suppress electromagnetic charge buildup, and low enough to avoid the risk of corrosion and condensation. To avoid air contamination from the humidifier, water treatment may be necessary in areas with high mineral content.

Air Supply and Flow

The air flow capacity of the facility where the HP 3PAR Storage systems are installed needs to be sufficient to remove the heat generated by the equipment. In addition, the air handlers must provide the airflow volume required by the units being cooled. To ensure this airflow, the facility must have a positive under the floor air pressure (if the facility has raised floors). When conditions within the computer room are changed (new units are added, the computer system is moved) airflow checks should be made.

The amount of outside (composition) air should be kept to the minimum needed to create a slight positive pressure within the room, and should not exceed industry recommendations of 0.3 cubic meter/minute (10 cubic feet/minute) per person stationed in the equipment room. While

recommendations for outside air in comfort air-conditioning are 10 to 15 percent of the airflow, the computer room environment is cleaner and operates more efficiently if outside air is kept below 1 percent of the airflow. Cooling/heating and humidification needs are reduced, and a minimum of contaminated building air is introduced into the installation area.

Air Cleanliness

Air contaminants can cause equipment malfunction and can damage HP 3PAR Storage systems. It is essential that steps be taken to prevent air contaminants, such as metal particles, solvent vapors, corrosive gases, soot, airborne fibers, or salt, from entering or being generated within the server room environment.

A high-efficiency air filter should be employed on each air inlet for outside air to stop dust at the point of entry to the installation site. Special additional filtering is necessary where the environment is exposed to salt air, corrosive gases, or unusual dust/dirt conditions. Electronic equipment is sensitive to air contaminants such as:

- Excessive amounts of soot particles
- Condensate particulates such as carbonates
- Concrete particulates from unsealed concrete
- Metal flakes or filings, such as those produced by sawing, filing, or drilling
- Floor-cleaning solutions with high ammonia content . Deteriorating/decomposing building materials, including floor tiles, fabrics, sheetrock, insulation, and acoustical tiles
- Pollutants generated by any servicing performed in and around the computer room
- Paper chaff, dust, and toners from printers within the computer room
- Processing chemicals from reproduction equipment such as microfiche processors.

In electronic equipment, contaminants cause connector contact and motor-bearing degradation. They also cause electrical leakage, shorting paths between integrated circuit leads and between printed wiring traces on printed circuit boards.

Air supplied to and circulated within the server room and under the floor plenums should ideally pass through mechanical or electrostatic filters. HVAC ducts and plenums and sub-floor areas, including cable raceway openings where used, should be kept clean. All unused cables, hardware, and debris should be removed from the under the floor area to avoid becoming dust/dirt traps or potential sources of rust.

During major changes in the server room environment, special considerations must be taken into account whenever any drilling, sawing, welding, brazing, etc., is performed.

Precautions must be taken to prevent material particles (concrete or metal particles, etc.) from becoming airborne. HP 3PAR Storage systems should be powered down during construction that requires any drilling, sawing, welding, brazing, etc. In addition, all debris must be removed before powering up the server(s). Maximum concentrations of corrosive gases and solvent vapors must also be considered.

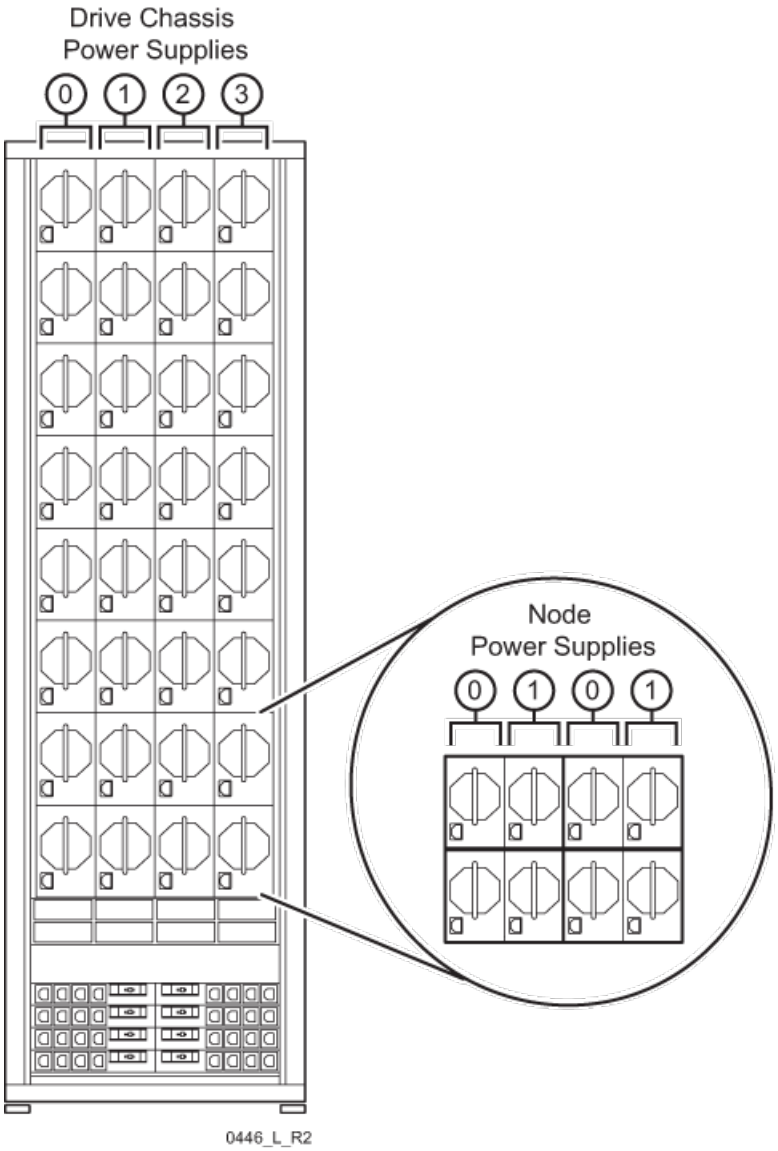
4 Power Requirements

This chapter describes the general power requirements for the HP 3PAR Storage systems.

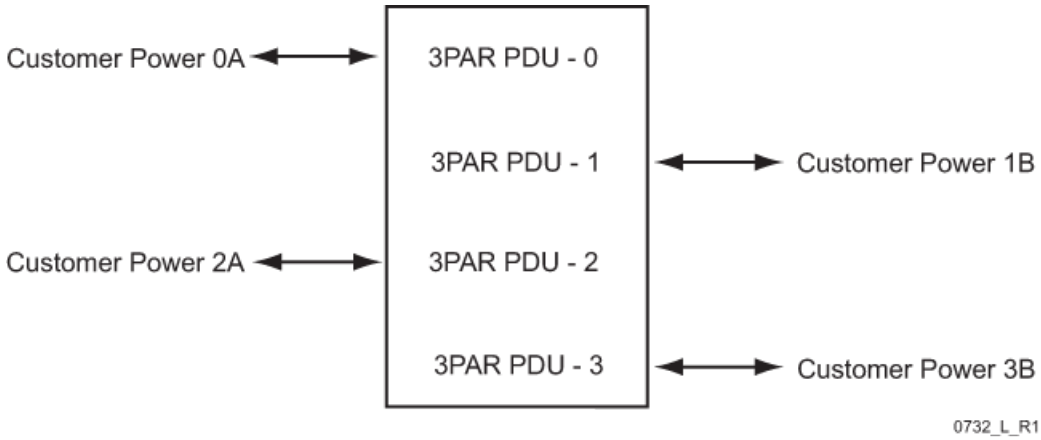
Powering HP 3PAR Storage Systems

The cabinets used to house the HP 3PAR Storage system components are divided into power domains where each contains a drive cage or controller node and two dedicated power supplies. Drive cages and controller nodes depend on these two power supplies, located at the rear of the system, to supply power from the Power Distribution Units (PDUs) that are located at the bottom of the cabinet.

Figure 13 Power Supplies Within the Power Domains



HP cabinets contain four PDUs and each requires service from a dedicated single-phase 200-240 VAC (200-250 VAC International), 30-A (32-A International) grounded electrical circuit. However, for optimal reliability and data accessibility, HP recommends a redundant AC configuration that uses independent sources to provide a dedicated, grounded electrical circuit to each PDU as shown in the following configuration:



NOTE: If a storage system cabinet does not have components installed in the top four bays (bays 0–3, or the highest 16U of the cabinet), the two upper PDUs (PDU 0 and PDU 1) are not used to power the system and need not be connected. Redundant power is still supplied to the lower bays in the cabinet through PDU 2 and PDU 3.

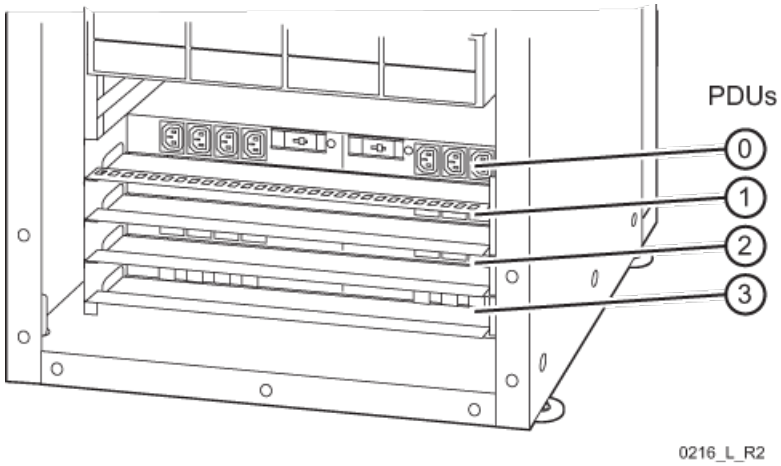
Storage server PDUs are equipped with NEMA® L6–30 or IEC 60309 connectors, depending on the region. International PDUs are equipped with IEC 60309, 2P+E (3 wire, 2 Pole + Earth Ground) connectors. The appropriate receptacles or adapters are necessary at the operating site to accommodate these connectors.

Power Distribution Units (PDUs)

For each cabinet, the four Power Distribution Units (PDUs) occupy the lowest chassis bay in the cabinet.

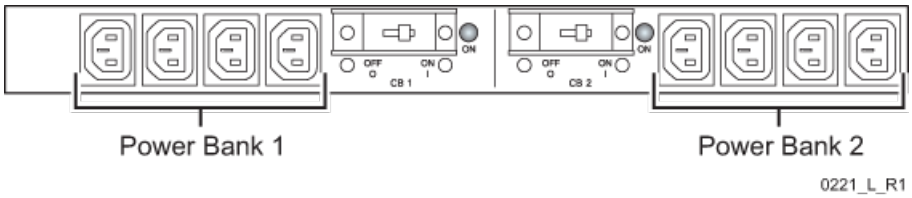
Figure Figure 14 (page 29) illustrates the four PDUs at the bottom of a 3PAR cabinet.

Figure 14 Power Distribution Units



Each PDU has two power banks, each with a separate circuit breaker, to be used exclusively for storage system components (Figure 15 (page 30)).

Figure 15 Power Banks in the PDU

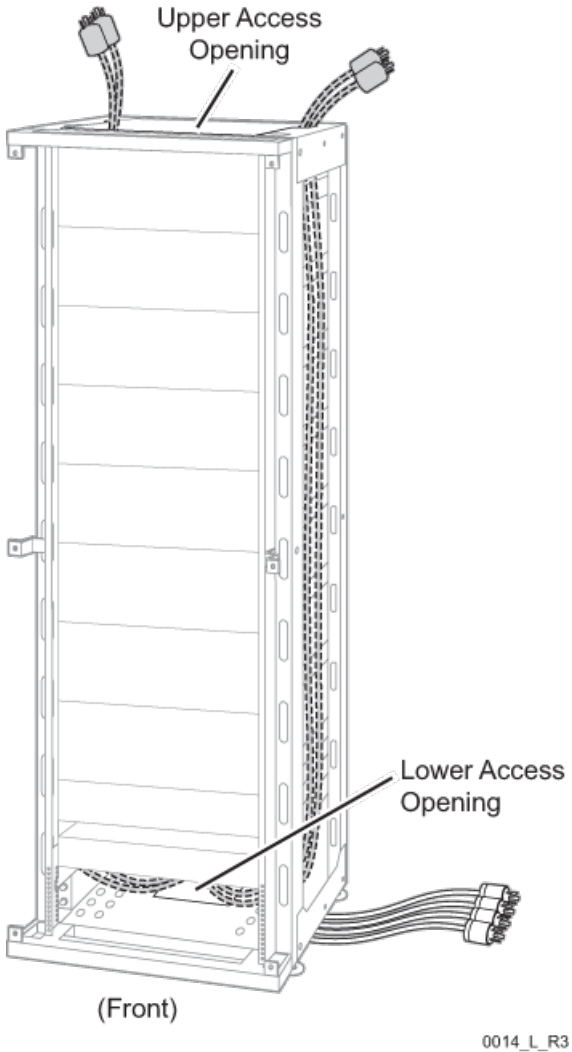


WARNING! To avoid possible injury, damage to storage system equipment, and potential loss of data, do not use the surplus power outlets in the storage system PDUs. Never use outlets in the PDUs to power components that do not belong to the storage system or to power storage system components that reside in other cabinets.

Power Cord Connections

Storage systems arrive with all internal power cords configured and connected. The AC cords connect two power supplies at the rear of the controller nodes and drive chassis to the PDUs at the bottom of the cabinet. The length of the power cord is 10 feet. The power cords can be routed through the lower access opening at the bottom of the cabinet or the upper access opening at the top of the cabinet (Figure 16 (page 30)). The side panels are removable for easier cabling access.

Figure 16 Power Cord Routing Options



NOTE: When routing the power cords through the bottom of the 2 meter cabinet, the usable cord length extends 9.5 to 10 feet away from the cabinet. If routing from the top, approximately 4 feet of the power cord is usable.

Electrical Requirements and Limitations

Before physically installing an HP 3PAR Storage system, verify that the operating site has the necessary electrical circuitry. Each HP 3PAR Storage system will require 4 (200 - 240) Volt, 30 Amp outlets or 2 outlets if only the bottom half of the cabinet is occupied. For proper redundant power protection, power should be supplied from two or more power sources.

HP recommends the installation site conform to the electrical specifications detailed in ANSI/TIA-942-2005 Annex G5, specifically:

- Use of K-rated isolation transformers, typically 480:208V/120 volt step-down transformers, will minimize any common mode noise between electrical ground and neutral. The voltage delta between power ground and signal ground will also be reduced. Isolation transformers should be located as close to the load as possible.
- Appropriate capacity Transient Voltage Surge Suppression (TVSS) devices should be installed at each level of the facility electrical distribution system. Each distribution panel should have its own dedicated TVSS. This multi-tiered approach has proven to be effective at reducing electrical transients.
- The installation site should have a comprehensive building ground system. A properly grounded building perimeter loop should be provided and the building steel should be bonded to the system at every other column. This building ground system should be directly bonded to all major power distribution equipment, including all switchgear, generators, UPS systems, transformers, etc., as well as to the telecommunications systems and lightning protection system.
- Installation of a UL Master-Labeled lightning protection system is recommended.

Use the approximate current requirements for storage system components listed in Table 5 (page 10) to estimate the current requirements for a specific system configurations.

Power Quality

The quality of the input power is critical to the performance and reliability of HP 3PAR Storage systems. Variations in the input power can cause a power failure or malfunction. Many of the causes of transient signals and noise on commercial power lines are difficult to locate or are beyond the customer's control. To reduce the impact of the irregularities, some form of power conditioning may be needed. Please consult your electrician for assistance.

Voltage and Frequency Tolerance

Steady state voltage must be maintained within 10 percent of the normal rated voltage, measured (under load) at the power input terminal of the specified server. The frequency must be maintained at (50-60 HZ), 1 phase 50/60 +2 percent, -4 percent.

When there is a possibility of brownouts or other marginal voltage conditions, installing a voltage monitor may be advisable.

Voltage Spikes

HP 3PAR Storage systems are tested to comply with the EN 61000-45 standard.

Installing a lightning protection device on the server room power source is recommended when the following conditions exist:

- The primary power is supplied by an overhead power service.
- The utility company installs lightning protectors on the primary power source.
- The area is subject to electrical storms or an equivalent type of power surge.

Electrostatic Discharge

HP 3PAR Storage systems are susceptible to failure due to electrostatic discharge (ESD). Electrostatic charges can accumulate on people and furniture because of direct contact with floor coverings or movement while in contact with furniture coverings. Discharge of static electricity to a metal surface on server cabinets can interfere with the system's operation and cause discomfort to anyone who comes in contact with it.

Some factors that contribute to electrostatic discharge are:

- High-resistance floor covering
- Carpeting without anti-static properties
- Low humidity (less than 20%)

HP 3PAR Storage systems are tested to comply with the EN 61000-45 standard.

Branch Circuits

The individual panel branch circuits should be protected by suitable circuit breakers properly rated according to manufacturer specifications and applicable codes. Each circuit breaker should be labeled to identify the branch circuit it is controlling. The receptacle should also be labeled. Plan on a circuit breaker maximum of 30 A per PDU (de-rated to 24 A).

Emergency Power Control

As a safety precaution, you might consider providing emergency power-off controls for disconnecting the main service wiring that supplies the HP 3PAR Storage systems. Install these controls at a convenient place for the operators and next to the main exit doors of the room after checking local electrical codes for further guidelines.

Redundant Power

HP 3PAR Storage systems with HP cabinets support redundant power within the system through the use of redundant PDUs and redundant power supplies.

As shown in Figure 17 (page 33) and Figure 18 (page 34), power domains within the storage system are distributed between the upper and lower halves of the cabinet.

Figure 17 Front View of the Power Domains Within the Controller Nodes and Drive Chassis

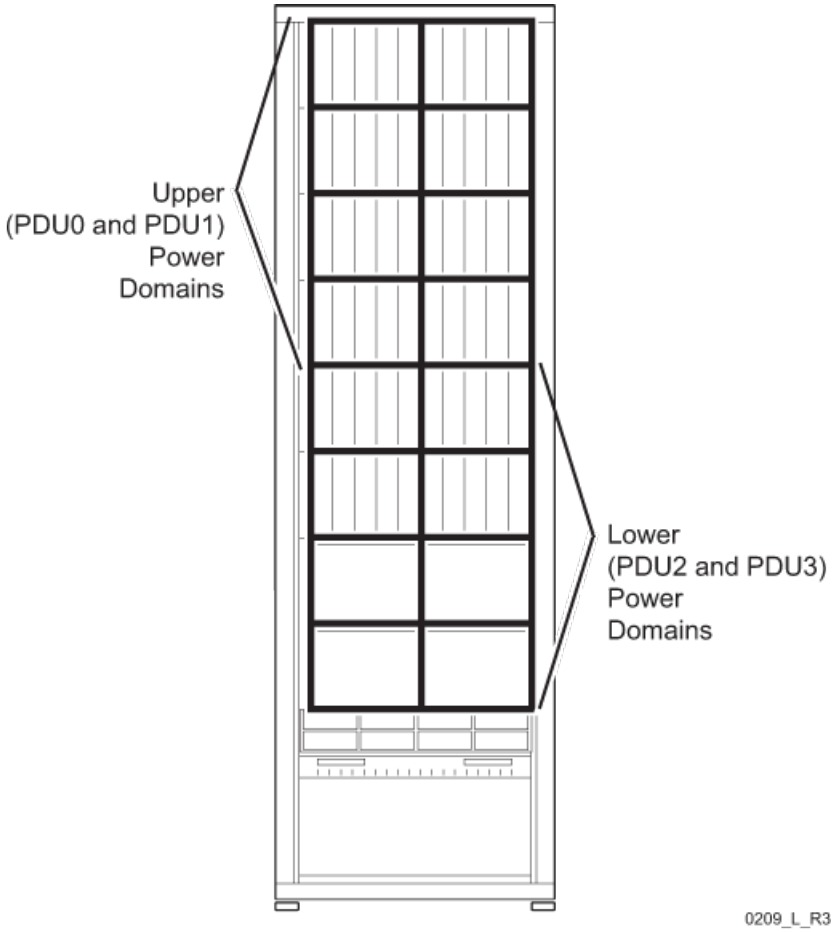
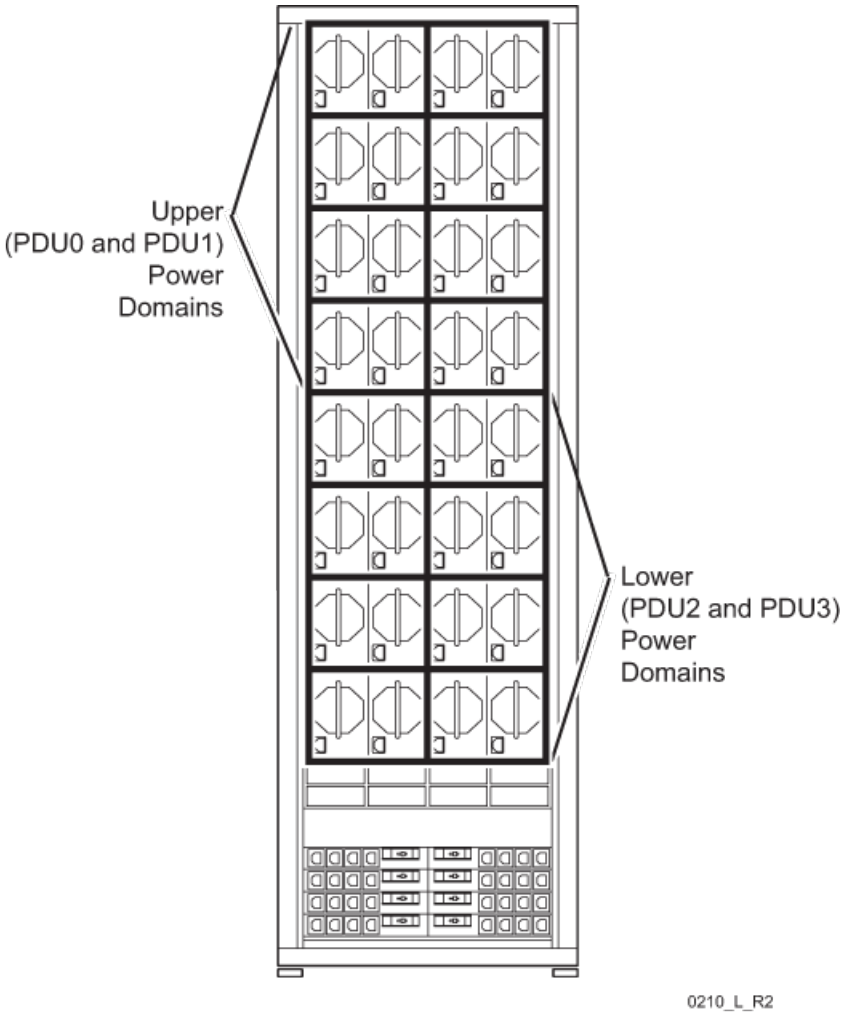


Figure 18 Rear View of the Power Domains Within the Controller Nodes and Drive Chassis



WARNING! To avoid possible injury, damage to storage system equipment, and potential loss of data, do not use the surplus power outlets in the storage system PDUs. Never use outlets in the PDUs to power components that do not belong to the storage system or to power storage system components that reside in other cabinets.

To support redundant power:

- The power supplies in each power domain must connect to separate PDUs.
- Each PDU in the system must connect to an independent AC circuit.

Figure 19 (page 35) and Table 15 (page 35) contain information about power cord connections for S800 and T800 storage systems with PDUs placed back-to-back to take up only 2U of cabinet space rather than the standard 4U of space.

NOTE: " Redundant Power Configuration Diagram (S800 and T800)" (page 35) applies only to the S800 and T800 configurations with front and rear PDUs.

Figure 19 Redundant Power Configuration Diagram (S800 and T800)

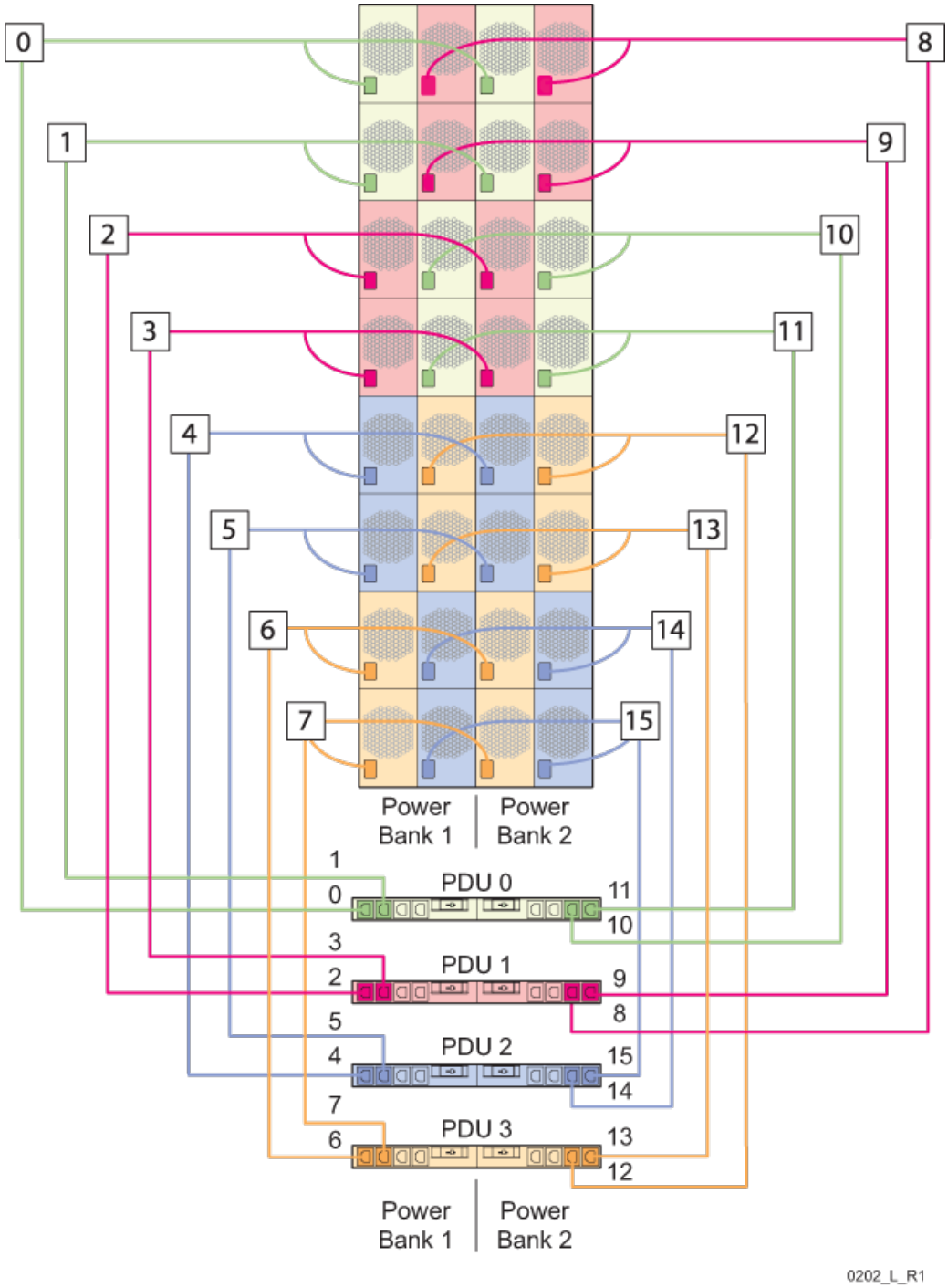


Table 15 Redundant Power Configuration (S800 and T800)

PDU Number	Power Bank	AC Cord
0	1	0-L,1-L
0	2	2-R,3-R
1	1	2-L,3-L
1	2	0-R,1-R
2	1	5-R,6-R
2	2	7-L,8-L

Table 15 Redundant Power Configuration (S800 and T800) *(continued)*

PDU Number	Power Bank	AC Cord
3	1	7-R,8-R
3	2	5-L,6-L

5 Network, Cabling and Connectivity

This chapter provides information about determining the best network configuration for the HP 3PAR Storage systems being installed at your site, necessary connections and cable routing options.

NOTE: The information that follows assumes an established network and discusses how to connect an HP 3PAR Storage system to that network.

Planning Network Access

External Ethernet, Fibre Channel (FC), iSCSI, and Remote Copy cable connections are completed at the time of installation.

These external connections are necessary to:

- Connect the storage system to the network, enabling storage system management through the InForm Management Console and CLI.
- Allow communication with the storage system from the Service Processor (SP) when in use.
- Enable HP Customer Service personnel to monitor and service the storage system via the SP. Refer to the *Secure Service Architecture* white paper for additional information.

NOTE: All networking equipment, including all necessary switches, hubs, and cables, are to be provided by the customer unless otherwise indicated.

Supported Network Topologies

Several different network topologies can be used to connect the storage system to the local area network, depending on operating site policies and requirements. Currently, the three major supported topologies are *shared* , *split* , and *private* . However, other possible network configurations might be available. To learn more, ask your sales and support representative.

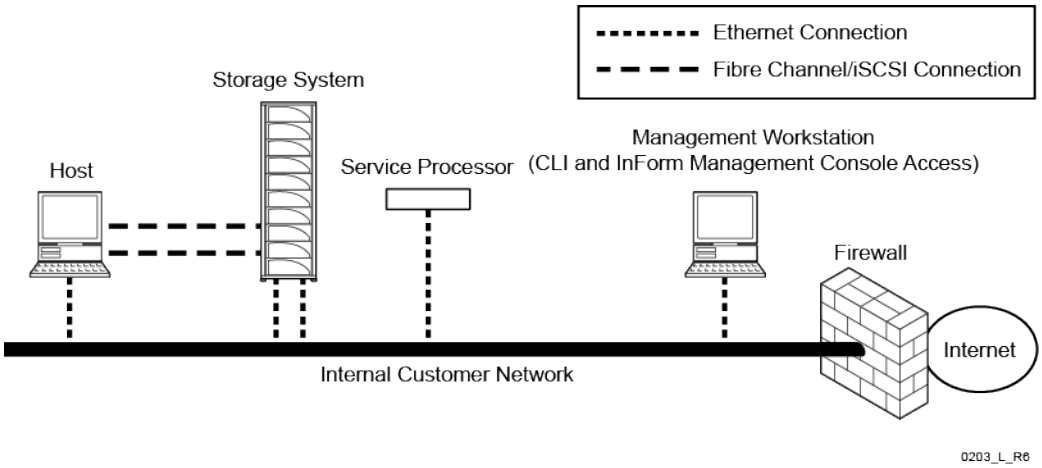
NOTE: To provide redundancy and to permit online software upgrades, both controller nodes in a single horizontal node pair (for example, nodes 0 and 1, nodes 2 and 3, and so on) must maintain connections to the internal customer network.

NOTE: The SP is often unused or powered off in the CC mode configuration. In some instances, the SP is only active for maintenance operations and software updates.

Shared Network

With a *shared* network topology, the storage system and SP share the internal customer network (Figure 20 (page 38)).

Figure 20 Storage System and SP on the Customer Network (Shared Topology)



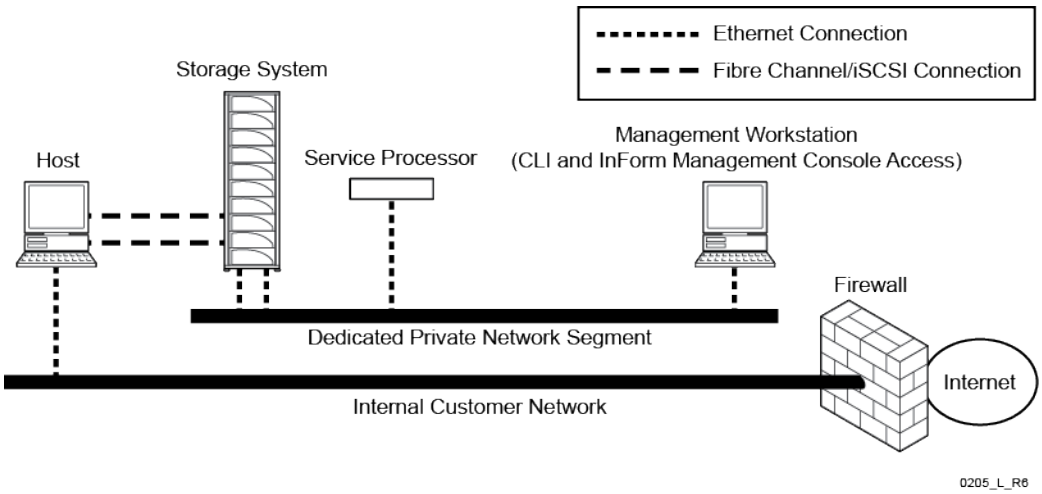
A *shared* topology requires:

- A static IP address and system name for the storage system.
- Two Ethernet connections from a switch or hub to the storage system controller nodes.
- A static IP address for the SP.
- One Ethernet connection from a switch or hub to the SP.
- At least one management station on the network segment.

Private Network

With a *private* network topology, the storage system and the SP sit on the same private network segment on the customer local area network. All management workstations used to administer the system must also sit on the same private network segment (Figure 21 (page 38)).

Figure 21 Storage System and SP on a Private Segment (Private Topology)



A *private* topology requires:

- A static IP address for the storage system.
- Two Ethernet connections from the storage system to a private network segment.
- One Ethernet connection from the SP to the private network segment.
- At least one management station on the private network segment.

NOTE: It is strongly recommended that the private network segment also have a management station to communicate with the SP.

NOTE: This configuration does not permit the SP to communicate with the remote support center.

TCP/IP Port Assignments

Table 16 (page 39) describes the TCP/IP port assignments for communication between various components:

Table 16 TCP/IP Port Usage Table

Port	Usage	Flow of Traffic
22: The Secure Shell (SSH) Protocol	Used for storage system monitoring and configuration through SSH connections by the following components: HP 3PAR Service Processor HP 3PAR InForm CLI Client	HP 3PAR Service Processor SSH Client -> HP 3PAR Storage System 3rd Party SSH Client <--> HP 3PAR Service Processor 3rd Party SSH Client <--> HP 3PAR CLI Client
80: World Wide Web HTTP	Used by the following component to communicate using the HTTP protocol: HP 3PAR Service Processor Not part of an evaluated configuration for Common Criteria	HP 3PAR Service Processor --> WWW
161: SNMP	Used for storage system monitoring and configuration by third-party SNMP Manager applications by the following component: • HP 3PAR SNMP Agent Not part of an evaluated configuration for Common Criteria	3rd Party SNMP Manager <-- > HP 3PAR SNMP agent
162: SNMPTRAP	Used by the HP 3PAR SNMP agent to send unsolicited alerts as SNMPv2c traps for 3rd party SNMP Manager applications by the following components: • HP 3PAR SNMP Agent Not part of an evaluated configuration for Common Criteria	3rd Party SNMP Manager <-- HP HP 3PAR SNMP agent
427: Service Location Protocol (SLP)	Used by the HP 3PAR CIM API to provide CIM Server location information by the following component: • HP 3PAR CIM Server Not part of an evaluated configuration for Common Criteria	3rd Party CIM Client <--> HP 3PAR CIM Server

Table 16 TCP/IP Port Usage Table *(continued)*

Port	Usage	Flow of Traffic
5781: HP 3PAR Event Reporting Service	Passes unsolicited events from the storage system and is used by the following component: • HP 3PAR Service Processor (This port was used for IMC events prior to OS version 2.3.1.) Not part of an evaluated configuration for Common Criteria	Service Processor <--> storage system Event Service
5782: HP 3PAR Management Service (unsecured)	Used for storage system monitoring and configuration over an unsecured channel by the following components: • HP 3PAR InForm Management Console • HP 3PAR InForm CLI • HP 3PAR Recovery Manager • HP 3PAR System Reporter • HP 3PAR Service Processor (Port 2540 used prior to 2.2.4.) Not part of an evaluated configuration for Common Criteria	HP 3PAR IMC <--> HP 3PAR CLI Server HP 3PAR CLI <--> HP 3PAR CLI Server Recovery Manager <--> HP 3PAR CLI Server HP 3PAR System Reporter <--> HP 3PAR CLI Server HP 3PAR Service Processor --> HP 3PAR CLI Server
5783: HP 3PAR Management Service with SSL (secured)	Used for storage system monitoring and configuration over a secured channel by the following components: • HP 3PAR InForm Management Console • HP 3PAR InForm CLI • HP 3PAR Recovery Manager • HP 3PAR System Reporter (Port 2550 was used prior to 2.2.4)	HP 3PAR IMC <--> HP 3PAR CLI Server HP 3PAR CLI <--> HP 3PAR CLI Server Recovery Manager <--> HP 3PAR CLI Server HP 3PAR System Reporter <--> HP 3PAR CLI Server HP 3PAR Service Processor --> HP 3PAR CLI Server
5785: HP 3PAR InForm Remote Copy	Used by the Remote Copy service to receive remote replication storage data sent by the Remote Copy service from another storage system Storage Array. Not part of evaluated configuration in CC mode. Remote Copy (Ports 3490/3491 used for 2.2.2 and prior -- ports 3491/3492 used for 2.2.3 and 2.2.4). Unsecured port used by the Remote Copy application to transport data (it does not exist on the management LAN and is only visible/active on RCIP network segments)	HP 3PAR Remote Copy on storage system <-- HP 3PAR Remote Copy on storage system (A dynamic port is allocated for sending data from the RC Service on the storage system.)
5988: WBEM CIM-XML (HTTP) (unsecured)	Used for storage system monitoring and configuration over an unsecured channel by the following component:	

Table 16 TCP/IP Port Usage Table *(continued)*

Port	Usage	Flow of Traffic
	HP 3PAR CIM Server Not part of an evaluated configuration for Common Criteria	3rd Party CIM Client <--> HP 3PAR CIM Server
5989: WBEMCIM-XML (HTTPS) (secured)	Used for storage system monitoring and configuration over a secured channel by the following component: HP 3PAR CIM Server Not part of an evaluated configuration for Common Criteria	3rd Party CIM Client <-->HP 3PAR CIM Server

NOTE: If configured to do so, the storage system is capable of communication with a customer defined host via UDP port 514 (syslog). Not part of an evaluated configuration for Common Criteria

Fibre Channel Connections

Fibre Channel adapters are used to connect to the customer FC switch and/or hosts and connect controller nodes to drive chassis within the system. The number of ports available for the host connection will vary based on the configuration. Depending on the number of controller nodes in the system, the type of Fibre Channel adapters installed, and the method of drive chassis connection being used, a storage system can support a maximum of 32 drive chassis. Controller nodes can hold a maximum of six PCI adapters (Figure 22 (page 42) for the S-Class and Figure 23 (page 42) for the T-Class).

NOTE: Ethernet Port (E0) is also used for the management interface connection.

Figure 22 S-Class Controller Node Fibre Channel Ports (Dual-Port Adapters)

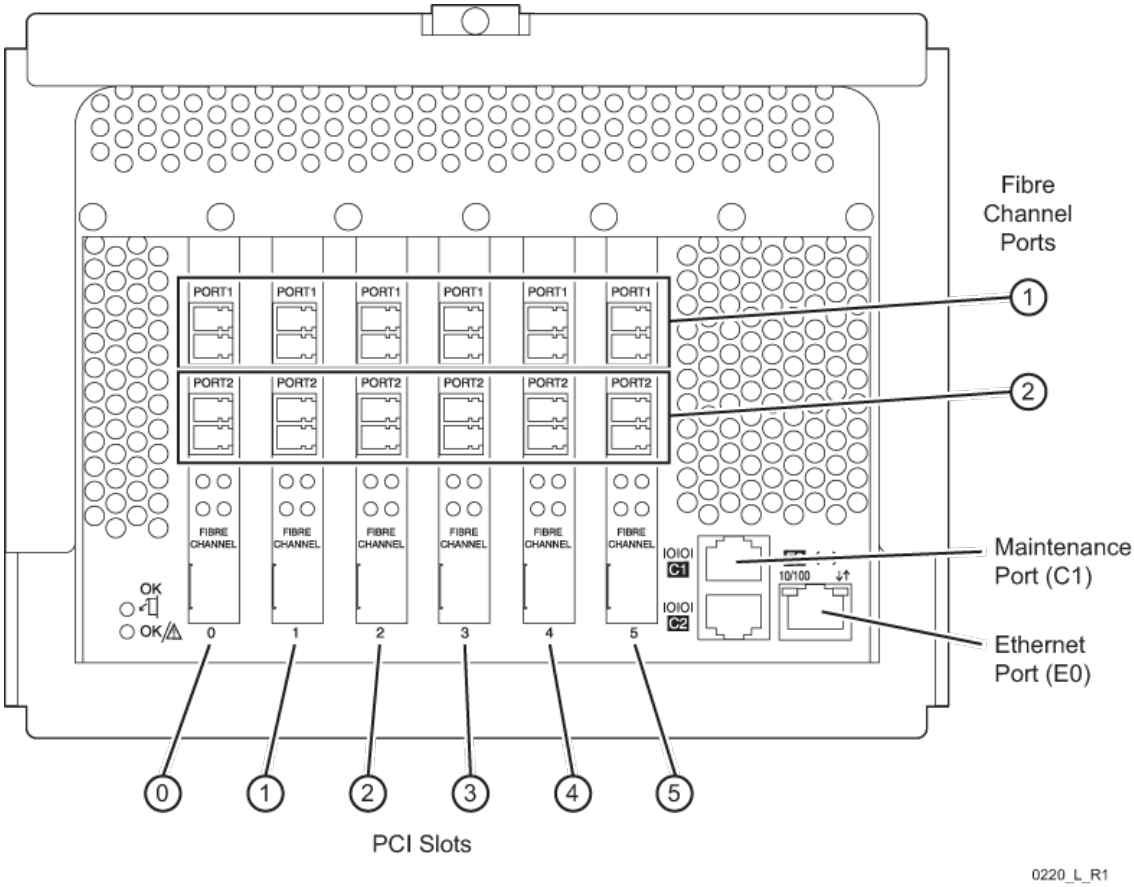
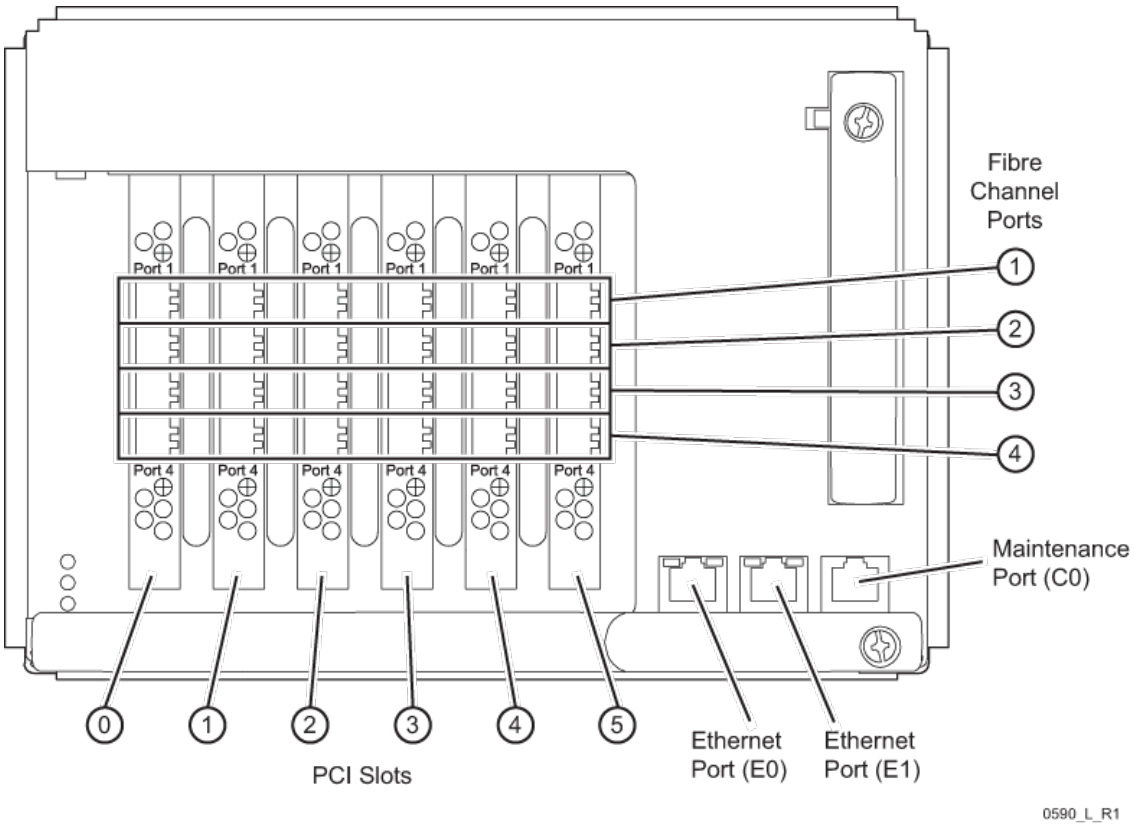


Figure 23 T-Class Controller Node Fibre Channel Ports (Dual-Port Adapters)



Fibre Channel adapters can have either two ports (*dual-port adapters*) or four ports (*quad-port adapters*).

Required Cables

The quantities and lengths of the cables required for storage system installation vary according to the specific storage system and network configuration. Fibre Channel cables are used externally to connect the controller node to the customer switch or host (in the case of a directly connected host). Fibre Channel cables are used internally to connect the controller node to the drive chassis (inter-cabinet or cabinet to cabinet).

The Fibre Channel cables provided by HP have a custom strain relief feature to help maintain the proper bend radius of the cables. For this reason, 3PAR requires that you use only Fibre Channel cables provided by HP. However, HP does not provide any networking cables or equipment such as Ethernet and modem cables. Table 7 (page 12) identifies the types of cables commonly required for storage system installation.

Table 17 Required Cables

Cable Type	Outside Diameter	Connector Type
Ethernet (Category 5) 3 cables minimum with 2 static IPs	Standard	RJ-45
Multi-mode Fibre Channel	1.6 mm	LC-LC or LC-SC
iSCSI	Standard	Cat-5, Cat-5e, Cat-6 copper (1–Gb/sec)

NOTE: For Ethernet and Fibre Channel cables that connect the storage system to the network and hosts, reserve approximately 7 feet (2 meters) of each cable for internal routing within the storage system cabinet. Measure the distance between the two cabinets and add 14 feet (4 meters) to determine the total length of cable required.

External Cable Connections

Table 18 (page 43) includes specific guidelines for connecting the controller nodes to the network and to host computers. Refer to "Supported Network Topologies" (page 37) for descriptions of the supported network topologies.

Table 18 External Controller Node Connections

Connection Type	Minimum Configuration	Recommended Configuration
Ethernet	Connection from the Ethernet switch or hub to two controller nodes	See "Supported Network Topologies" (page 37)
Fibre Channel	Connection from a host computer to one controller node	Separate connections from host computers to each node, via a switch, with connections distributed evenly across all nodes[1]
iSCSI	Connection from a host computer to one controller node	Separate connections from host computers to each node, via a switch, with connections distributed evenly across all nodes[2]
Maintenance	None	Varies according to system and network configuration

[1] To provide redundancy and to permit online software upgrades, both controller nodes in a single horizontal node pair (for example, nodes 0 and 1, nodes 2 and 3, and so on) must maintain connections to each host server.

[2] To provide redundancy and to permit online software upgrades, both controller nodes in a single horizontal node pair (for example, nodes 0 and 1, nodes 2 and 3, and so on) must maintain connections to each host server.

- Each controller node supports one Ethernet connection to a switch or hub. Separate connections from the Ethernet switch or hub to at least two controller nodes are required to support redundancy.

  With redundancy, one IP address is shared between the two connections and only one network connection is active at a time. If the active network connection fails, the IP address is automatically moved to the surviving network connection.

- At a minimum, the storage system requires one Fibre Channel (or iSCSI) connection from a host computer to a controller node. However, separate connections from each host computer to each of the controller nodes in the storage system, with connections distributed evenly across all nodes, are recommended.
- Establish direct connections from the controller nodes to the host computer or computers.

(Table 9 (page 12)) shows the maximum supported Fibre Channel cable length based on the cable size and port speed.

Table 19 Cable Limitations for Fibre Channel Host Connectivity

Cable Size	Speed	Cable Length Limit
62.5 micron	2 Gbps	100 meters
62.5 micron	4 Gbps	70 meters
50 micron	2 Gbps	300 meters
50 micron	4 Gbps	150 meters

Internal Cable Connections

For storage systems housed in single cabinets, internal system Fibre Channel cabling is complete upon arrival. For multiple-cabinet configurations, the installation technician completes connections between the controller node cabinet and the drive chassis cabinet or cabinets.

NOTE: For important exceptions to the cabling rules and guidelines described in this section, see the *HP 3PAR InForm OS Administrator's Guide* .

The following table (Table 8 (page 12)) shows the typical HP Fibre Channel cable lengths required for a given type of connection:

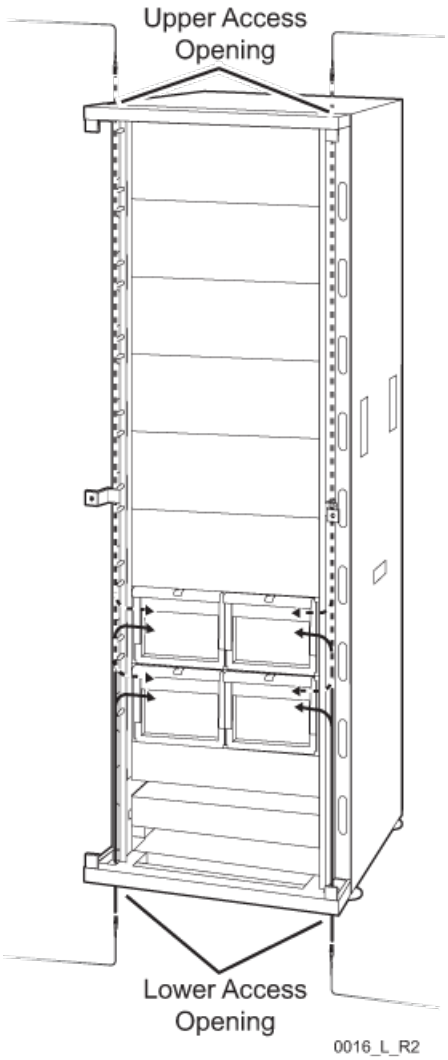
Table 20 Fibre Channel Cable Usage Guidelines

Cable Length	Used for...
2 m	drive chassis to controller node connections in the same side of the same cabinet (for example, an even-numbered drive cage to an even-numbered node).
4 m	drive chassis to controller node connections across the same cabinet (for example, an even-numbered drive cage to an odd-numbered node).
10m 50m 100m	cabling between cabinets. Always round up to the nearest size.

Cable Routing Options

Storage system cabinets have both upper and lower access openings available for Fibre Channel cable routing (Figure 24 (page 45)). It is also possible to route network cables and main power cords through specially designated upper and lower openings in the cabinet.

Figure 24 Bringing Cables Into the Cabinets Through Access Openings



NOTE: For GbE, iSCSI and Fibre Channel cables that connect the storage system to the customer network or hosts, approximately 7 feet (2 meters) of each cable must be reserved for internal routing within the storage system cabinet.

Service Processor Connections

The SP provides support for on-site diagnostic and maintenance activities for HP 3PAR Storage systems (hardware and software maintenance). It can also be used to provide remote monitoring and support. The SP is not a part of the evaluated Common Criteria configuration. Refer to the *HP 3PAR InForm OS Common Criteria Administrator's Reference* for additional information.

Connecting the Service Processor

The SP uses customer-supplied connections, as outlined in "Supported Network Topologies" (page 37). Table 21 (page 46) provides general guidelines for completing these external connections.

Table 21 SP Connections

Connection type	Configuration
Ethernet	For SP: connection from the RJ-45 connector in the ETH 0 port at the rear of the SP to an Ethernet hub or switch (Figure 24 (page 45) or ???).
Modem (optional)	Connection from the line serial port at the rear of the SP to an RJ-11 modular telephone outlet.

6 Support and Other Resources

Contacting HP

For worldwide technical support information, see the HP support website:

http://www.hp.com/support

Before contacting HP, collect the following information:

- Product model names and numbers
- Technical support registration number or Service Agreement ID (if applicable)
- Product serial numbers
- Error messages
- Operating system type and revision level
- Detailed questions

Specify the type of support you are requesting:

HP 3PAR storage system	Support request
HP 3PAR StoreServ 7200, 7400, and 7450 Storage systems	StoreServ 7000 Storage
HP 3PAR StoreServ 10000 Storage systems HP 3PAR T-Class storage systems HP 3PAR F-Class storage systems	3PAR or 3PAR Storage

HP 3PAR documentation

For information about:	See:
Supported hardware and software platforms	The Single Point of Connectivity Knowledge for HP Storage Products (SPOCK) website: http://www.hp.com/storage/spock
Locating HP 3PAR documents	The HP 3PAR StoreServ Storage site: http://www.hp.com/go/3par To access HP 3PAR documents, click the **Support** link for your product.
HP 3PAR storage system software	
Storage concepts and terminology	*HP 3PAR StoreServ Storage Concepts Guide*
Using the HP 3PAR Management Console (GUI) to configure and administer HP 3PAR storage systems	*HP 3PAR Management Console User's Guide*
Using the HP 3PAR CLI to configure and administer storage systems	*HP 3PAR Command Line Interface Administrator's Manual*
CLI commands	*HP 3PAR Command Line Interface Reference*
Analyzing system performance	*HP 3PAR System Reporter Software User's Guide*
Installing and maintaining the Host Explorer agent in order to manage host configuration and connectivity information	*HP 3PAR Host Explorer User's Guide*
Creating applications compliant with the Common Information Model (CIM) to manage HP 3PAR storage systems	*HP 3PAR CIM API Programming Reference*

For information about:	See:
Migrating data from one HP 3PAR storage system to another	*HP 3PAR-to-3PAR Storage Peer Motion Guide*
Configuring the Secure Service Custodian server in order to monitor and control HP 3PAR storage systems	*HP 3PAR Secure Service Custodian Configuration Utility Reference*
Using the CLI to configure and manage HP 3PAR Remote Copy	*HP 3PAR Remote Copy Software User's Guide*
Updating HP 3PAR operating systems	*HP 3PAR Upgrade Pre-Planning Guide*
Identifying storage system components, troubleshooting information, and detailed alert information	*HP 3PAR F-Class, T-Class, and StoreServ 10000 Storage Troubleshooting Guide*
Installing, configuring, and maintaining the HP 3PAR Policy Server	*HP 3PAR Policy Server Installation and Setup Guide* *HP 3PAR Policy Server Administration Guide*

For information about:	See:
Planning for HP 3PAR storage system setup Hardware specifications, installation considerations, power requirements, networking options, and cabling information for HP 3PAR storage systems	
HP 3PAR 7200, 7400, and 7450 storage systems	*HP 3PAR StoreServ 7000 Storage Site Planning Manual* *HP 3PAR StoreServ 7450 Storage Site Planning Manual*
HP 3PAR 10000 storage systems	*HP 3PAR StoreServ 10000 Storage Physical Planning Manual* *HP 3PAR StoreServ 10000 Storage Third-Party Rack Physical Planning Manual*
Installing and maintaining HP 3PAR 7200, 7400, and 7450 storage systems	
Installing 7200, 7400, and 7450 storage systems and initializing the Service Processor	*HP 3PAR StoreServ 7000 Storage Installation Guide* *HP 3PAR StoreServ 7450 Storage Installation Guide* *HP 3PAR StoreServ 7000 Storage SmartStart Software User's Guide*
Maintaining, servicing, and upgrading 7200, 7400, and 7450 storage systems	*HP 3PAR StoreServ 7000 Storage Service Guide* *HP 3PAR StoreServ 7450 Storage Service Guide*
Troubleshooting 7200, 7400, and 7450 storage systems	*HP 3PAR StoreServ 7000 Storage Troubleshooting Guide* *HP 3PAR StoreServ 7450 Storage Troubleshooting Guide*
Maintaining the Service Processor	*HP 3PAR Service Processor Software User Guide* *HP 3PAR Service Processor Onsite Customer Care (SPOCC) User's Guide*
HP 3PAR host application solutions	
Backing up Oracle databases and using backups for disaster recovery	*HP 3PAR Recovery Manager Software for Oracle User's Guide*
Backing up Exchange databases and using backups for disaster recovery	*HP 3PAR Recovery Manager Software for Microsoft Exchange 2007 and 2010 User's Guide*
Backing up SQL databases and using backups for disaster recovery	*HP 3PAR Recovery Manager Software for Microsoft SQL Server User's Guide*
Backing up VMware databases and using backups for disaster recovery	*HP 3PAR Management Plug-in and Recovery Manager Software for VMware vSphere User's Guide*
Installing and using the HP 3PAR VSS (Volume Shadow Copy Service) Provider software for Microsoft Windows	*HP 3PAR VSS Provider Software for Microsoft Windows User's Guide*
Best practices for setting up the Storage Replication Adapter for VMware vCenter	*HP 3PAR Storage Replication Adapter for VMware vCenter Site Recovery Manager Implementation Guide*
Troubleshooting the Storage Replication Adapter for VMware vCenter Site Recovery Manager	*HP 3PAR Storage Replication Adapter for VMware vCenter Site Recovery Manager Troubleshooting Guide*
Installing and using vSphere Storage APIs for Array Integration (VAAI) plug-in software for VMware vSphere	*HP 3PAR VAAI Plug-in Software for VMware vSphere User's Guide*

Servicing HP 3PAR storage systems

For information about:	See:
Maintaining the HP 3PAR Service Processor	

Initializing and using the Service Processor	*HP 3PAR Service Processor Software User Guide: Service Edition*
Upgrading the Service Processor	*HP 3PAR Service Processor Software Upgrade Instructions: Service Edition*
Troubleshooting the Service Processor	*HP 3PAR Service Processor Troubleshooting Guide: Service Edition*
Remotely servicing all storage systems	
Remotely servicing HP 3PAR storage systems	*HP 3PAR Secure Service Collector Remote Operations Guide*
Servicing 7200 and 7400 storage systems	
Maintaining, servicing, and upgrading 7200 and 7400 storage systems	*HP 3PAR StoreServ 7000 Storage Service Guide: Service Edition*
Troubleshooting 7200 and 7400 storage systems	*HP 3PAR StoreServ 7000 Storage Troubleshooting Guide: Service Edition*
Servicing 10000 storage systems	
Using the Installation Checklist	*HP 3PAR StoreServ 10000 Storage Installation Checklist (for HP 3PAR Cabinets): Service Edition*
Upgrading 10000 storage systems	*HP 3PAR StoreServ 10000 Storage Upgrade Guide: Service Edition*
Maintaining 10000 storage systems	*HP 3PAR StoreServ 10000 Storage Maintenance Manual: Service Edition*
Installing and uninstalling 10000 storage systems	*HP 3PAR StoreServ 10000 Storage Installation and Deinstallation Guide: Service Edition*
Servicing T-Class storage systems	
Using the Installation Checklist	*HP 3PAR T-Class Storage System Installation Checklist (for HP 3PAR Cabinets): Service Edition*
Upgrading T-Class storage systems	*HP 3PAR T-Class Storage System Upgrade Guide: Service Edition*
Maintaining T-Class storage systems	*HP 3PAR T-Class Storage System Maintenance Manual: Service Edition*
Installing and uninstalling the T-Class storage system	*HP 3PAR T-Class Installation and Deinstallation Guide: Service Edition*
Servicing F-Class storage systems	
Using the Installation Checklist	*HP 3PAR F-Class Storage System Installation Checklist (for HP 3PAR Cabinets): Service Edition*
Upgrading F-Class storage systems	*HP 3PAR F-Class Storage System Upgrades Guide: Service Edition*
Maintaining F-Class storage systems	*HP 3PAR F-Class Storage System Maintenance Manual: Service Edition*
Installing and uninstalling the F-Class storage system	*HP 3PAR F-Class Storage System Installation and Deinstallation Guide: Service Edition*

Typographic conventions

Table 22 Document conventions

Convention	Element
Bold text	• Keys that you press • Text you typed into a GUI element, such as a text box • GUI elements that you click or select, such as menu items, buttons, and so on
`Monospace text`	• File and directory names • System output • Code • Commands, their arguments, and argument values
`<Monospace text in angle brackets>`	• Code variables • Command variables
`Bold monospace text`	• Commands you enter into a command line interface • System output emphasized for scannability

WARNING! Indicates that failure to follow directions could result in bodily harm or death, or in irreversible damage to data or to the operating system.

CAUTION: Indicates that failure to follow directions could result in damage to equipment or data.

NOTE: Provides additional information.

Required

Indicates that a procedure must be followed as directed in order to achieve a functional and supported implementation based on testing at HP.

HP 3PAR branding information

- The server previously referred to as the "InServ" is now referred to as the "HP 3PAR StoreServ Storage system."
- The operating system previously referred to as the "InForm OS" is now referred to as the "HP 3PAR OS."
- The user interface previously referred to as the "InForm Management Console (IMC)" is now referred to as the "HP 3PAR Management Console."
- All products previously referred to as “3PAR” products are now referred to as "HP 3PAR" products.

7 Documentation feedback

HP is committed to providing documentation that meets your needs. To help us improve the documentation, send any errors, suggestions, or comments to Documentation Feedback (docsfeedback@hp.com). Include the document title and part number, version number, or the URL when submitting your feedback.

A Regulatory information

For important safety, environmental, and regulatory information, see *Safety and Compliance Information for Server, Storage, Power, Networking, and Rack Products*, available at http://www.hp.com/support/Safety-Compliance-EnterpriseProducts.

Turkey RoHS material content declaration

Türkiye Cumhuriyeti: EEE Yönetmeliğine Uygundur

Ukraine RoHS material content declaration

Обладнання відповідає вимогам Технічного регламенту щодо обмеження використання деяких небезпечних речовин в електричному та електронному обладнанні, затвердженого постановою Кабінету Міністрів України від 3 грудня 2008 № 1057

Warranty information

HP ProLiant and X86 Servers and Options

http://www.hp.com/support/ProLiantServers-Warranties

HP Enterprise Servers

http://www.hp.com/support/EnterpriseServers-Warranties

HP Storage Products

http://www.hp.com/support/Storage-Warranties

HP Networking Products

http://www.hp.com/support/Networking-Warranties